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SUPPLEMENT TO  
PHOTOGRAPHIC  
INTELLIGENCE  
CENTER - REPORT

UNCLASSIFIED

Japanese

# ELECTRONICS

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OPNAV - 16 - VP 101  
MARCH 1945

No P.O. M. &

**UNCLASSIFIED**  
**PHOTOGRAPHIC INTELLIGENCE REPORT**

# **JAPANESE ELECTRONICS**

- **R A D A R**
- **R A D I O**
- **DIRECTION FINDING**
- **NAVIGATIONAL AIDS**

**UNITED STATES NAVAL PHOTOGRAPHIC INTELLIGENCE CENTER**  
**NAVY YARD, WASHINGTON 25, D. C.**

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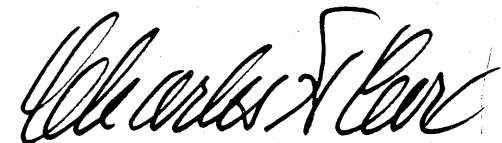
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# FOREWORD

Purpose of Report:

1. To compile a pictorial reference on Japanese Electronics installations.
2. To develop Photographic Interpretation techniques for extracting needed information on Electronics from aerial photographs.
3. To present coordinated Electronics information in combination with Photographic Interpretation data in order to supply maximum intelligence on enemy installations.

Additional looseleaf pages will be issued to holders of this report at such times as important new information becomes available.



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## ACKNOWLEDGMENT . . .

is made to all of the many military activities from whom advice, criticism and published material has been sought in the process of writing this report, and in particular to the personnel of the NAVAL RESEARCH LABORATORY who have contributed freely of their time and invaluable information.

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# TABLE OF CONTENTS

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# CONTENTS

## INTRODUCTION

### SECTION 1

#### RADAR

SUMMARY .....	1.01
LAND BASED SEARCH .....	1.03
MOBILE AND PORTABLE .....	1.14
SHIP BORNE .....	1.18
AIR BORNE .....	1.20
FIRE AND SEARCHLIGHT CONTROL .....	1.22
SUPPLEMENTARY MATERIAL .....	1.26
GERMAN .....	1.27

### SECTION 2

#### COMMUNICATIONS

SUMMARY .....	2.01
HIGH FREQUENCY .....	2.07
MEDIUM FREQUENCY .....	2.08
LOW FREQUENCY .....	2.12
COMMUNICATION CENTERS .....	2.18
WEATHER STATIONS .....	2.25
SUPPLEMENTARY MATERIAL .....	
GERMAN .....	2.28

### SECTION 3

#### DIRECTION FINDING

SUMMARY .....	3.01
HIGH FREQUENCY .....	3.06
MEDIUM FREQUENCY .....	3.11
D. F. CENTERS .....	3.17
SUPPLEMENTARY MATERIAL .....	
GERMAN .....	3.18

### SECTION 4

#### NAVIGATIONAL AIDS

SUMMARY .....	4.01
FOR SHIPS AND AIRCRAFT .....	4.02
SUPPLEMENTARY MATERIAL .....	
GERMAN .....	4.05

### SECTION 5

#### ELECTRONICS COMBINATIONS

MARCUS .....	5.01
MATSUWA .....	5.02
KURABU CAPE, PARAMUSHIRO .....	5.03
CHICHI JIMA .....	5.04
SUPPLEMENTARY MATERIAL .....	5.05

### SECTION 6

#### RELATED INSTALLATIONS

POWER .....	6.01
TRANSFORMERS .....	6.02
TRANSMISSION LINES .....	6.04
SUPPLEMENTARY MATERIAL .....	6.05

### SECTION 7

#### COMPARATIVE STUDIES

RADIO MASTS .....	7.01
OBSERVATION TOWERS .....	7.04
DIRECTION FINDERS .....	7.05
SIGNAL TOWERS .....	7.06
MISCELLANEOUS .....	7.07
SUPPLEMENTARY MATERIAL .....	

### SECTION 8

#### SEARCHLIGHTS

SEE SEPERATE INDEX .....	8.01
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# INTRODUCTION

## JAPANESE ELECTRONICS

Prepared November 1944, replaces "Japanese Radio-Radar and Related installations" (P.I.C. No. 2 - 5/6/8/9/-K-1/44) and is a revised and enlarged edition of the latter. (Certain examples of German Electronics are included because of German equipment and technicians available for Japanese use.)

For further and detailed information on Japanese electronics equipment see Naval Research Laboratory Report #RA3A215B entitled: "Technical Data on Japanese Radio and Radar Equipment."

This report deals mainly with four distinct types of electronics installations. The interpreter should clearly understand the exact functions of each.

### RADAR

(Radio Detecting and Ranging)

1. Transmits and receives.
2. Provides early warning of approaching aircraft and surface vessels.
3. Used in connection with gunfire to give accuracy of range and deflection (called "Fire Control" type).
4. May be used for Navigational purposes.

### COMMUNICATIONS

("Radio")

1. Transmits and receives spoken word or code.

### DIRECTION FINDERS

(Receives Radio Signals)

1. Detects radio and records range and direction.
2. Aid to Navigation - It is believed this is a primary use of Japanese installations.

### NAVIGATIONAL AIDS

(Navigational Beam)

1. Transmits radio signals creating a "beam" for guiding ships and planes to home base or to bombing target.

Tendencies towards standardization are an inevitable outgrowth of development, especially in the electronics field. Because of this, the interpreter's job with respect to newly covered installations becomes easier in direct proportion to his familiarity with the old or captured installations.

It is with this purpose in mind that a large number of photographic examples of known installations are included and an attempt made to group them in a logical manner, reflecting their use in waging war.

Frequencies are given in connection with all installations, to enable the interpreter to check his visual interpretation against frequency data obtained from radio signals picked up from any particular area.

## SCALE

In order to establish a more realistic yardstick of the possibilities of electronics interpretation, the following table of photographic scales is prepared.

The first column represents the smallest scale at which the object may usually be recognized.

The second column suggests a scale at which a good detailed interpretation can usually be made.

It is assumed that good quality prints are available and that the interpreter knows what he is looking for.

RADAR	RECOGNITION	DETAIL
Fixed types	1/10000	1/5000
Mobile types	1/8000	1/5000
Fire Control	1/5000	1/2000
COMMUNICATIONS		
Lattice masts	1/15000	1/8000
Stick masts	1/10000	1/5000
DIRECTION FINDERS		
Open Adcock	1/18000	1/11000
Housed Adcock	1/15000	1/10000
Portable or unusual types	1/8000	1/5000

### NAVIGATIONAL AIDS

Vary considerably in size and type.

## FREQUENCIES

RADAR . . . . .	VHF, UHF, SHF (30-30000 Mcs.)
COMMUNICATIONS . . . . .	VLF, LF, MF, HF, VHF (0.01-30 Mcs.)
DIRECTION FINDERS . . . . .	MF, HF (0.3-30 Mcs.)
NAVIGATIONAL AIDS . . . . .	LF, MF, HF, VHF (0.03-300 Mcs.)

In general: low frequencies indicate long ranges; high frequencies indicate short ranges. This is true of all types of electronics shown.

## STANDARD FREQUENCY TABLE

SHF -- Super High Frequency . . . . .	3000-30000 Mcs. ("microwave")
UHF -- Ultra High Frequency . . . . .	300-3000 Mcs.
VHF -- Very High Frequency . . . . .	30-300 Mcs.
HF -- High Frequency . . . . .	3-30 Mcs.
MF -- Medium Frequency . . . . .	300-3000 Kcs. (0.3-3 Mcs.)
LF -- Low Frequency . . . . .	30-300 Kcs. (0.03-0.3 Mcs.)
VLF -- Very Low Frequency . . . . .	10-30 Kcs. (0.01-0.03 Mcs.)
D.F. -- . . . . .	Direction Finder.

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# SECTION-1

1.01 - 1.99

# R A D A R



In an effort to eliminate confusion with respect to Japanese Radar Designations, the following table is included. In cases where popular names have developed, the popular name is used for page headings.

# JAPANESE RADAR DESIGNATIONS

POPULAR NAME	JAPANESE TEMPORARY DESIGNATION	JAPANESE ABBREVIATED DESIGNATION
"Guadalcanal" type . . . . .	Mark 1, Model 1 . . . . .	Mark 11
"Attu" type . . . . .	Mark 1, Model 1, Modification 1 . . . . .	Mark 11
"Mobile Mattress" . . . . .	Mark 1, Model 2 . . . . .	Mark 12
"Mark 6 Portable" . . . . .	Air Mark 6 "Special" . . . . .	?
"Mark 13 Portable" . . . . .	Mark 1, Model 3 . . . . .	Mark 13
"Wewak Yagi" . . . . .	"YA" . . . . .	Mark B ?
"Chi" . . . . .	"Chi" . . . . .	Mark 229
"Ship Mattress" . . . . .	Mark 2, Model 1 . . . . .	?
Ship "2-Horn" type . . . . .	Mark 2, Model 2 . . . . .	Mark 51
Ship "3-Horn" type . . . . .	Mark 2, Model 2 Modification 2 . . . . .	Mark 61
"Parabaloid" . . . . .	Mark 2, Model 3 . . . . .	Mark 52
_____ . . . . .	Air Mark 6, Model 4 . . . . .	Mark 6
_____ . . . . .	Mark 4, Model 1 . . . . .	Mark 21
_____ . . . . .	Mark 4, Model 2 . . . . .	Mark 21
_____ . . . . .	Mark 4, Model 3 . . . . .	Mark 42?
_____ . . . . .	Mark "TA", Model 1 . . . . .	?
_____ . . . . .	Mark "TA", Model 2 . . . . .	?
_____ . . . . .	Mark "TA", Model 3 . . . . .	?

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# RADAR

## SUMMARY

In principle, all Radar systems are alike, although individual installations may vary widely in physical aspects as well as tactical use. Examples of land based, airborne, and ship mount radar are shown and discussed in this section.

Simply stated Radar is an electronic device which emits continuous stream of radio waves of extremely high frequencies (70 to 30,000 Mcs.) which, when reflected back from a dense obstruction in their path, are received and presented on a cathode ray tube to record position and range of that obstruction in a visual manner.

Each installation both transmits and receives.

Radar will not penetrate land forms, buildings, ships and planes, and, therefore records them by reflection. Generally, Radar will penetrate clouds and foliage, however, rain-laden dense cumulus clouds may be picked up, as may be dense forest.

Radar waves travel in a straight line except for atmospheric refraction which bends the beam earthwards, and which is important beyond the 20 mile range. Very little is known as yet concerning the exact effects of refraction (called "propagation"). However, it is considered reasonable, in order to plot radar waves as a straight line, to regard the earth as being  $\frac{4}{3}$  of its actual diameter when calculating the effect of curvature of the earth on radar "shadows" under "standard" weather conditions.

### LAND BASED SEARCH RADAR

The Japanese often locate search Radar on high points in mountainous areas, and on a high concrete base in low flat areas. This enables the radar to search greater ranges close to the earth's surface. Radar sites are very often near the seacoast.

When two Radars are used in close proximity it is likely to be for the following reasons:

1. One may search while the other tracks objective.
2. Two may be required to complete coverage of all required sectors of search.
3. The additional set may be erected as a supplementary installation in the event of damage or malfunctioning of the first set.

It is important that interpreters learn to associate the graphic appearance and sizes of Radar types with their known frequency band, for as information on signals received is usually available, it is possible to make a positive and exact identification in this way.

### INTERPRETATION FEATURES

1. Size and shape of screen.
2. Blast wall sometimes present (example: Kiska).

3. Often mounted on high concrete base, particularly low coral islands (example: Makin).
4. Generator building often visible (example: Marcus).
5. May be found as twin installation (example: Kiska).
6. Site will be free from dense obstructions in area of required coverage.

### REPORTING ON SEARCH RADAR

In Photographic Interpretation reports on radar installations, the following information is desirable :

1. Exact location and elevation above sea level.
2. Probable area of search (nearby obstructions etc.).
3. Height of screen above ground.
4. Generator Building location - if visible.
5. Size and shape of screen (note particularly if parabolic or horn.)
6. Operation of screen.
  - (a) fixed
  - (b) rotates
  - (c) elevates
  - (d) tips upward
7. Design of base for screen.
8. Probable use of installation.
9. Type of radar - if known.
10. Frequency, Pulse Length, Pulse Frequency.

### RANGE

Ranges of Radar equipment cannot be cited in exact figures due to variations caused by weather conditions, size of objective, radar operators skill etc. However, rough ranges are given in connection with each type in the following pages.

The concern of the Japanese with respect to Radar and its development and use is expressed in the following excerpt from a captured Japanese notebook, probably written from a class lecture early in 1944.

"The value of radar (in firing action) is tremendous. We must quickly marshall its full capabilities since it is the very essence of the present war of science. Great advantages can be gained by progress in radar. Those responsible for meeting the present war situation in its tactical phases must examine the essential elements and endeavor to obtain maximum efficiency in both men and equipment in the Imperial Navy. A glance at the present condition of the fleet reveals that the ships of those with an active interest (TN: in radar) are well-equipped in all essential details and the accuracy of some of the equipment has exceeded all expectations. On the other hand there are many who lack confidence in its use and feel that radar is a white elephant on their hands. We must strive all the more for the perfection of radar by further research and training."

# RADAR

## SUMMARY (CONT.)

TABLE OF IMPORTANT JAPANESE RADAR TYPES

	POPULAR NAME	JAPANESE DESIGNATION	ANTENNA	FREQUENCY IN MCS.	P.R.F. IN CPS.	PULSE LENGTH IN MICROSECONDS	MAXIMUM RANGE IN NAUTICAL MILES						USE	REMARKS	PAGE NO.
							A/C Form	A/C Single	BR CA	CL	OD	SS			
LAND-BASED SEARCH	GUADALCANAL TYPE	MARK 1, MODEL 1	26'x18'	97-103	880-1200	12-30	75	35-45	13	10	8	--	A.W.	FIRST FOUND ON GUADALCANAL	1.05
	"ATTU TYPE"	MARK 1, MODEL 1 MODIFICATION 1	28'x14'x2 1/3'	97-103	880-1200	12-30	75	35-45	13	10	8	--	A.W.	'BOX' TYPE ANTENNA	1.10
	"MOBILE MATTRESS"	MARK 1, MODEL 2	14'x7'x1 2/3'	187-205	800-1500	3 1/2-12	100	75	--	--	--	--	A.W.	OFTEN FOUND EMPLACED IN A REVETMENT	1.14
	"MARK VI PORTABLE"	AIR MARK VI "SPECIAL"	7' YAGI DIPOLES MOUNTED ON COLLAPSIBLE TRIPOD	140-160	1000	3-5	75?	--	--	--	--	--	A.W.	PORTABLE ADAPTATION OF AIR-BORNE SET	1.16
	"MARK 13 PORTABLE"	MARK 1, MODEL 3	VARIOUS-USING ARRAYS OF 7' YAGI DIPOLES	140-160	500	10	45	--	--	--	--	--	A.W.	MAY BE IMPROVED AIR MARK VI WITH HIGHER POWER. SET IS PORTABLE.	1.16
	"WEWAK TYPE"		2 HORIZONTAL ROWS OF (YAGI?) DIPOLES ON A MAST	60-80	750	25-35	125	90	--	--	--	--	A.W.	TRANSPORTABLE PHOTOGRAPHED AT WEWAK 1943. INCREASING USE.	1.17
	"CHI"	"CHI" OR MARK 229	SIMILAR TO WEWAK TYPE	60-80	500 OR 1000	25-35	125	90	--	--	--	--	A.W.	FIXED TRANSMITTER T. AND R. ARE AT SEPARATE LOCATIONS. INCREASING USE.	1.17
SHIP-BORNE	"SHIP MATTRESS"	MARK 2, MODEL 1	14'x7'x1 2/3' (SIMILAR TO MOBILE MATTRESS)	187-205	1000	10	100	75	20	15	12	--	A.W. S.W.	SAME AS MOBILE MATTRESS WITH A DIFFERENT ANTENNA MOUNT.	1.18
	"2-HORN TYPE"	MARK 2, MODEL 2	2 ELECTRO-MAGNETIC HORNS APPROX. 3' LONG	3000	2500	6	--	--	25	18	12	8	S.W.	HORNS MAY BE IN TURNABLE. RECEIVER IS HIGHER THAN TRANSMITTER.	1.18
	"3-HORN TYPE"	MARK 2, MODEL 2 MODIFICATION 2	3 ELECTRO-MAGNETIC HORNS APPROX. 3' LONG	3000	2500	6	--	--	25	18	12	8	S.F.C. S.W.	RECEIVER HORN IS REPLACED BY DOUBLE HORN ATTACHMENT	1.18
	"PARABALOID"	MARK 2, MODEL 3	PROBABLY PARABALOID	520	---	30	--	25	15	--	--	--	S.W. A.W. F.C.A?	FOR SMALL CRAFT. PROBABLY ADAPTATION OF GERMAN WIRZBURG. (CAPTURED DOCUMENTS ONLY)	--
AIR-BORNE		AIR MARK VI MODEL 4	VARIOUS: YAGI, DIPOLES, ARRAYS	140-160	1000	3-5	15	10	25	18	12	--	A.S.V. A.I.	FIRST USED IN BETTY. NOW IN ALL TYPES OF PLANES WITH VARIOUS ANTENNA DESIGNS	1.20
FIRE AND SEARCHLIGHT CONTROL							ACCURACY RANGE BEARING ELEVATION								
		MARK IV, MODEL 1 (S-3)	MATTRESS 25 3/4'x6'x4'	200	2000	3-5	50 YDS	0.5°	0.5°				A.A.F.C. A.W.	ADAPTATION OF OUR SCR 238	1.25
		MARK IV, MODEL 2 (ALSO MODIF. 2)	PROBABLY MATTRESS	200	1000	3	50 YDS	0.5°	0.5°				A.A.F.C. A.W.	SMALLER AND IMPROVED MK IV, MODEL 1 FOR MASS PRODUCTION (CAPTURED DOCUMENTS ONLY)	1.25
		MARK IV, MODEL 3	4 YAGIS ON S/L 1 YAGI ON S/L CONTROLLER	200	2000	3-5	100 YDS	1°	1°				A.A.F.C. S.L.C.	SIMILAR TO BRITISH "SLC" BUT TRANSMITTING ANTENNA SEPARATED	1.22
		MARK "TA", MODEL 1	4 YAGIS WITH TRANS. ANTENNA ATTACHED ABOVE	200	---	3	--	--	--				A.A.F.C.	(CAPTURED DOCUMENTS ONLY)	1.23
		MARK "TA", MODEL 2	5 YAGIS - EACH WITH REFLECTOR	200	1000	2	100 YDS	--	--				A.A.F.C. A.W.	(CAPTURED DOCUMENTS ONLY)	1.23
		MARK "TA", MODEL 3	ELABORATE ANTENNAE SYSTEM T/R SEPARATED	75?	1000-2000	1-2	25 YDS	0.5°	1°				A.A.F.C.	ADAPTATION OF BRITISH "GL" MARK 2 (CAPTURED DOCUMENTS ONLY)	1.24

P.R.F. - PULSE REPETITION FREQUENCY  
C.P.S. - CYCLES PER SECOND

A.W. --- AIR WARNING  
S.W. --- SURFACE WARNING  
S.F.C. - SURFACE FIRE CONTROL

A.A.F.C. - A/A FIRE CONTROL  
S.L.C. - SEARCHLIGHT CONTROL  
A.S.V. - AIRPLANE SEARCH FOR SURFACE CRAFT  
A.I. --- AIRBORNE INTERCEPT

NOTE: IN ADDITION TO THE ABOVE, GERMAN RADAR TYPES MAY BE FOUND IN USE IN JAPANESE CONTROLLED AREAS.



# RADAR SUMMARY

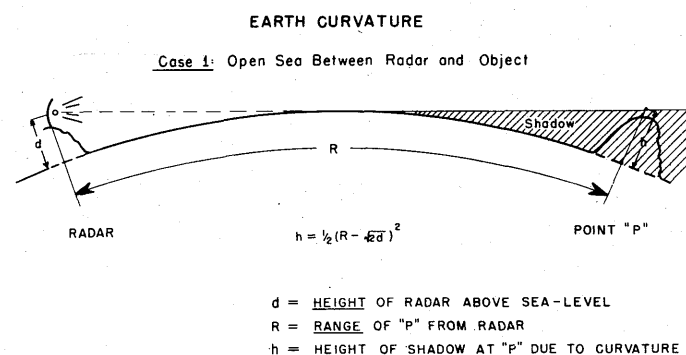
The following diagrams were prepared by the Special Devices Division of the Bureau of Aeronautics, Navy Department, for use in connection with terrain models and special R.P.D. equipment.

They are included here because they constitute a rapid way of estimating enemy radar coverage, with or without the use of terrain models.

Charts, prepared by Gen. Hq., S.W.P.A., are available for plotting Japanese Radar coverage and propagation according to type of Radar and number of A/C in formation.

Curvature can be neglected within 20 miles of the radar site, and outside of that range relatively few curvature computations are required. These computations fall into two simple classes:

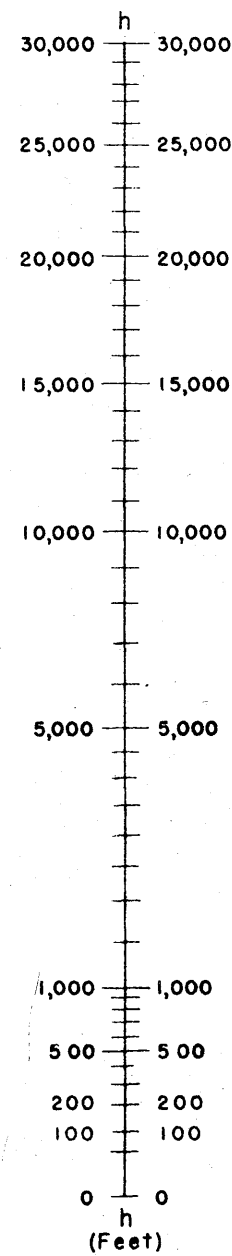
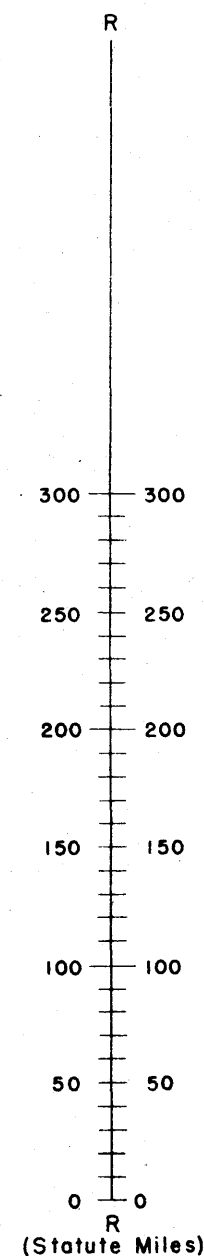
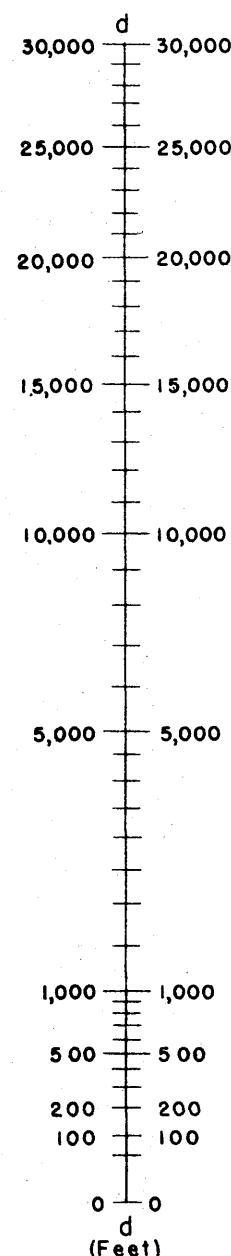
**CASE 1: OPEN SEA BETWEEN RADAR AND OBJECT.** In this case no shadow will be present on the flat model. Referring to diagram, if "h" is greater than the height above sea level of the terrain at "P", no ground echo will appear on the radar.



## HOW TO USE NOMOGRAPH

Pass a ruler through the points on the two vertical lines representing known quantities, and read off the solution at the intersection of the third line with the ruler.

d = HEIGHT OF RADAR ABOVE SEA-LEVEL  
R = RANGE OF "P" FROM RADAR  
h = HEIGHT OF SHADOW AT "P" DUE TO CURVATURE



Example: If the radar is at 1250 feet, the shadow height at 200 miles is found by lining up the ruler with "d" = 1250 and "R" = 200. The ruler will then pass through "h" = 11,250 feet, which is the solution.

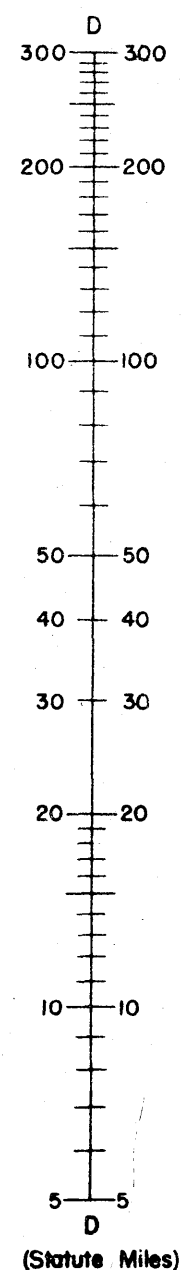
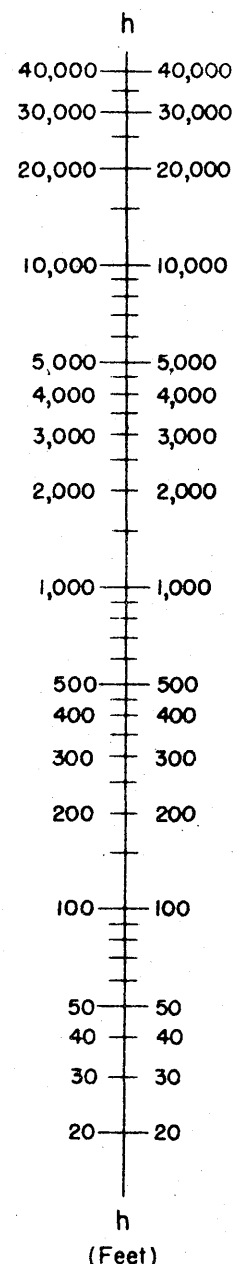
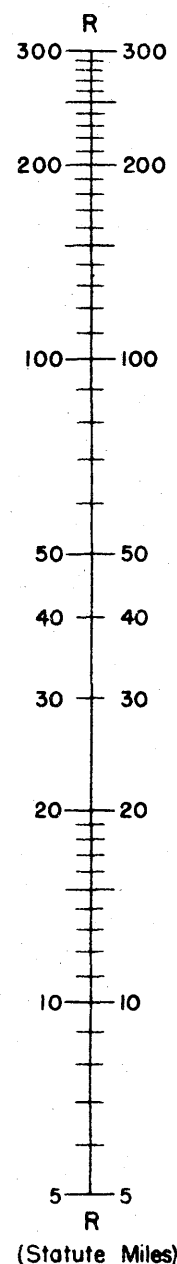
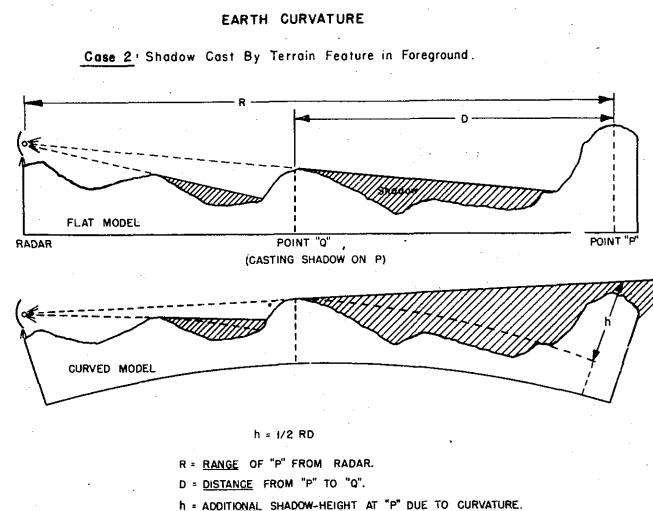
# RADAR

## SUMMARY

**CASE 2: SHADOW CAST BY A TERRAIN FEATURE IN THE FOREGROUND.** In this case the shadow edge at a point "P" will be raised by earth curvature by an amount which depends on the range of "P" and the distance between "P" and the feature which casts the shadow. Referring to page 42, if the amount which the mountain at "P" protrudes above the shadow edge on the flat model is less than the computed "h", the effect of curvature will be to remove the mountain from the beam.

Whenever a hill is found to disappear into shadow as a result of curvature computations, a shadow cannot be cast by this hill on objects still more distant. Should such a problem arise, elevate the hill with a pencil or any convenient object to the computed shadow edge, and use the new shadow (cast on the more distant object by the pencil) as the basis for making a case 2 computation.

Note: In rare cases, it may be difficult to decide whether case 1 or case 2 applies. In such circumstances apply both, and take the higher of the two computed shadows.

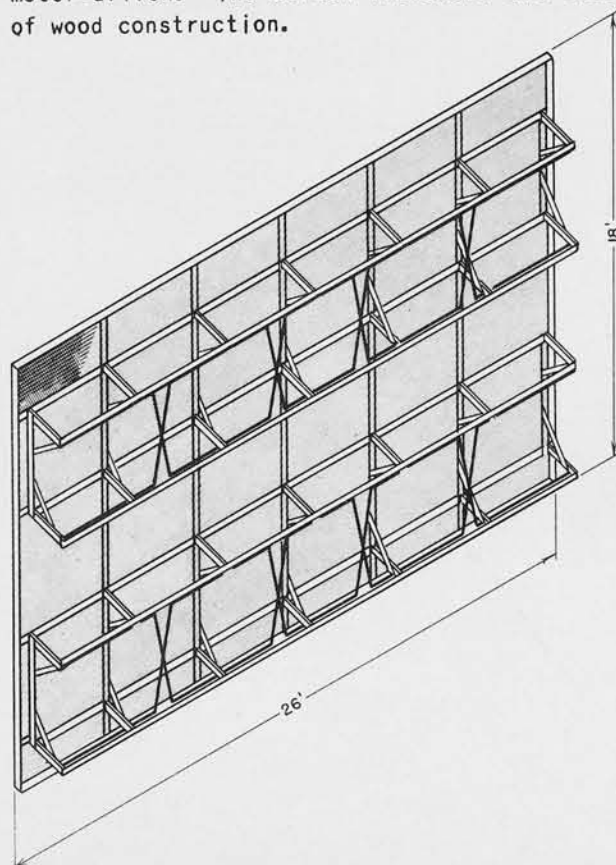


Example: Suppose the distant point "P" is at a range of 200 miles, and the object casting a shadow on "P" is at a distance of 150 miles from "P". Passing the ruler through "R" = 200 and "D" = 150, the answer "h" = 15,000 feet will appear at the intersection of the ruler and the center scale.

# RADAR GUAD. TYPE

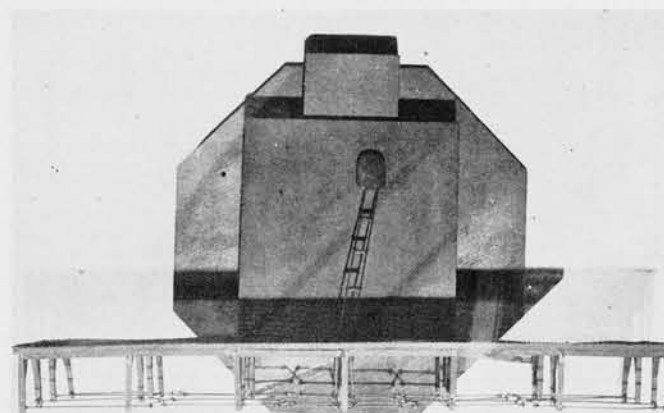
The first captured Japanese Radar, found on Guadalcanal, is shown on this page.

The antenna is five "elements" (half-wave dipoles) wide. Each section is 2 dipoles high. Polarization is horizontal (i.e. The dipoles lie horizontally rather than vertically). The screen is backed with chicken wire type mesh. This equipment has a frequency of 96.5 to 103 Mcs. It is primarily for early warning of aircraft approach and gives range and bearing with a maximum range of 50 to 60 miles for high-flying aircraft. The antenna rotates with the shack to which it is attached but does not elevate. The shack is motor-driven. The screen framework and shack are of wood construction.



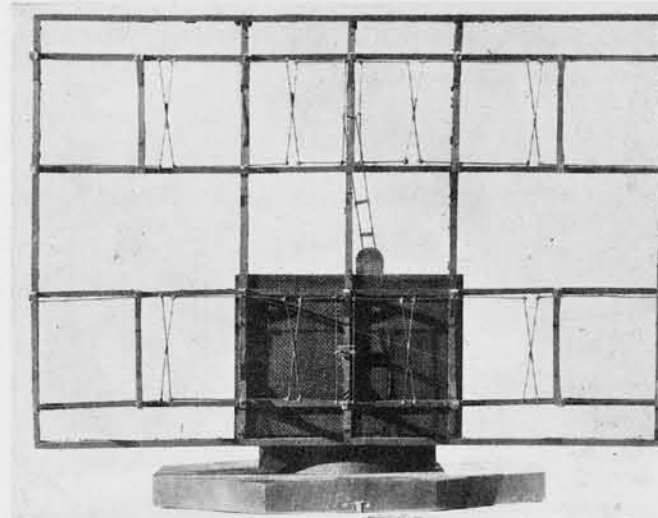
Drawing of Guadalcanal type screen with steel framework, which typifies all later models.

LOCATION.....	GUADALCANAL
TYPE..... (MARK I, MODEL I).....	"GUADALCANAL"
ANTENNA.....	26' x 18'
FREQUENCY.....	100 MCS
P.R.F. ....	880 - 1200 .. PULSE.. 12 - 30
MAXIMUM RANGE.....	60 N. MI.



## GUADALCANAL, SOLOMONS

ABOVE: Plan view of a scale model. Note small appendage at rear of control shack which is characteristic of Guadalcanal and Attu type radars.

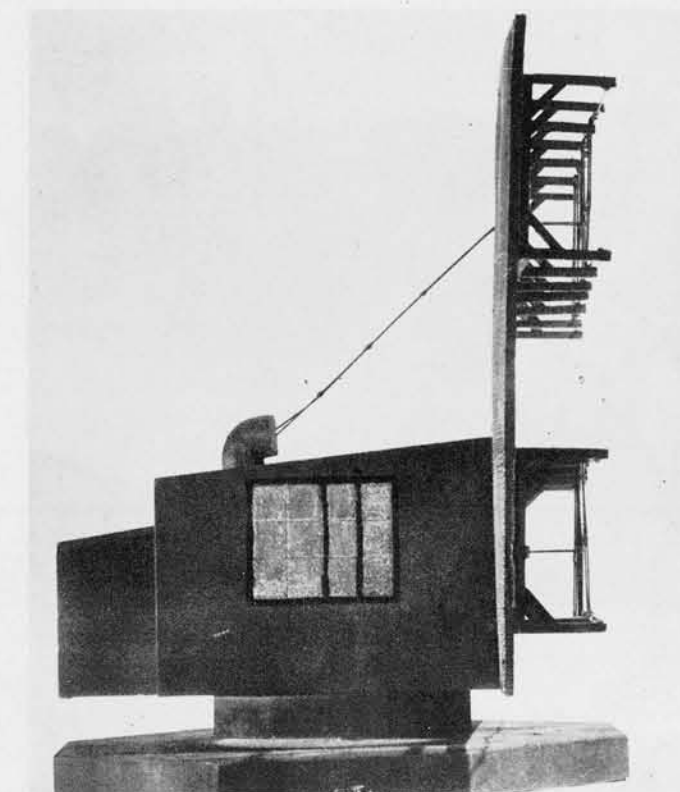


## GUADALCANAL, SOLOMONS

ABOVE, front view of scale model showing details of the antenna.



## GUADALCANAL, SOLOMONS



## GUADALCANAL, SOLOMONS

ABOVE: Side view of scale model showing shed roof which is characteristic of all Guadalcanal types. The screen framework here is of wood. Later models incorporated the use of steel for structural framework.

BELOW: Low obliques taken at Guadalcanal.



## GUADALCANAL, SOLOMONS

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# RADAR

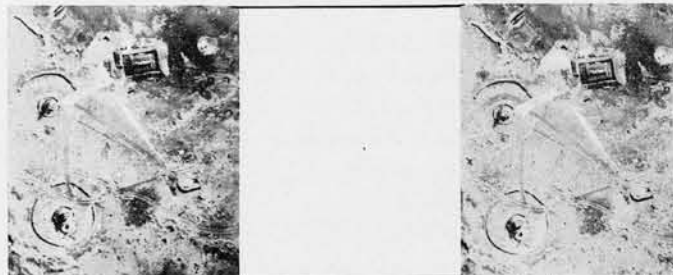
GUAD. TYPE (CONT.)



KISKA, ALEUTIANS

(R.F. - 1 1200)

ABOVE: note strong screen shadows. Generator building not present, power coming from a removed source. Revetment 1 foot high and 32 feet in diameter. Distance between screens is 130 feet.



KISKA, ALEUTIANS

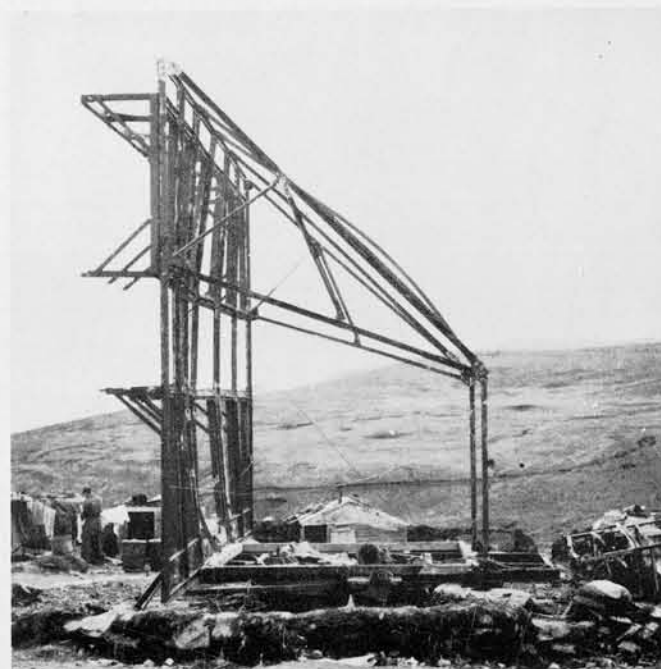
(R.F. - 1/3600)

The Guadalcanal type radar is now constructed as shown on this page, with a metal screen frame-work.

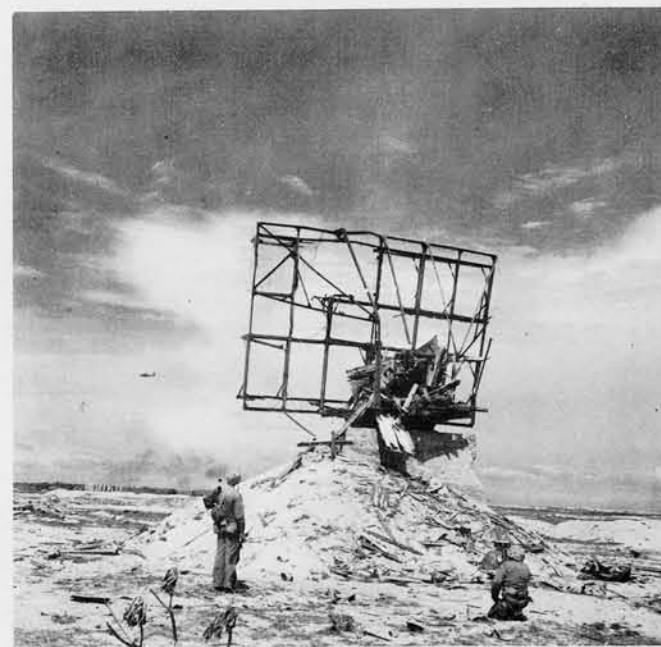
Both localities afford examples of twin installations, where one set may be used for search while the other tracks a specific target.

Screen is 28 feet wide and 18 feet high. Control shack, which rotates with screen, is 10' x 10' with an additional small square projection on side opposite screen.

LOCATION . . . . . KISKA  
TYPE . . . (MARK I, MODEL I) . . . . "GUADALCANAL"  
ANTENNA . . . . . 26' x 18'  
FREQUENCY . . . . . 100 MCS  
P.R.F. . . . . 880-1200 . . . . PULSE . . 12-30  
MAXIMUM RANGE . . . . . 75 N. MI.

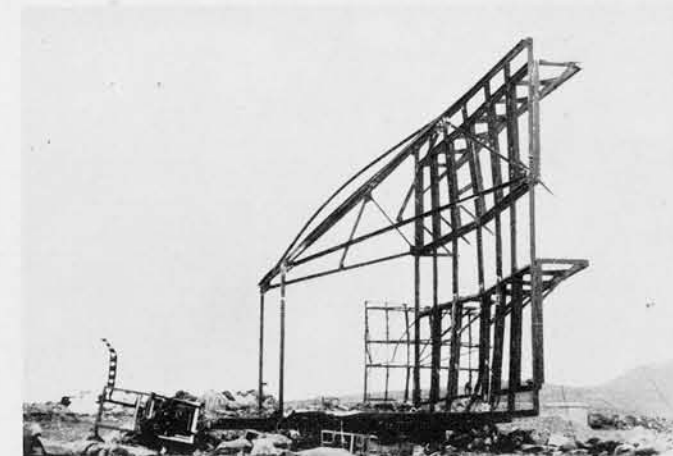


KISKA, ALEUTIANS

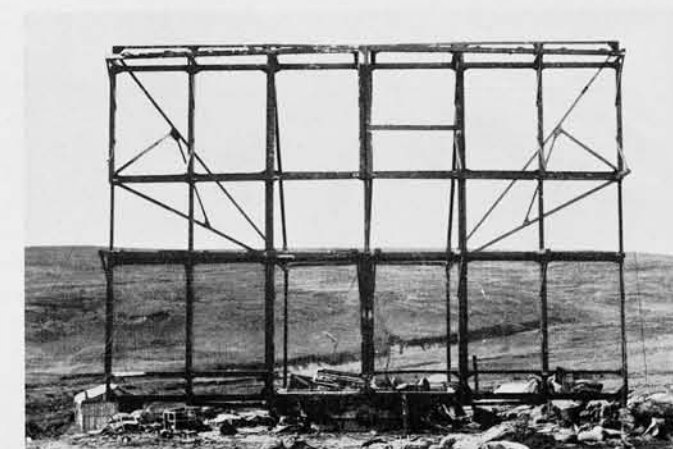


KWAJALEIN, MARSHALLS

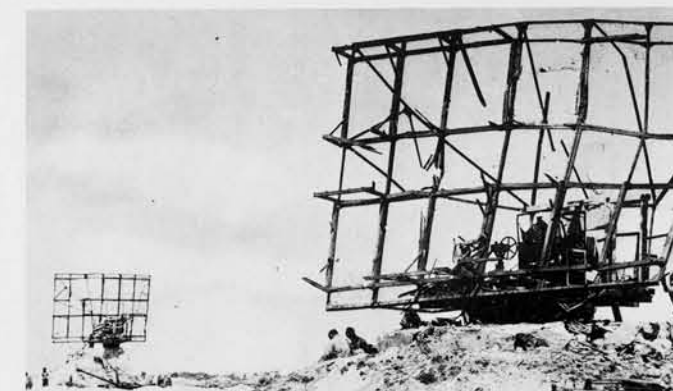
ABOVE: note elevated emplacement used on low coral island. This is the same type of radar as seen at Kiska.



KISKA, ALEUTIANS



KISKA, ALEUTIANS

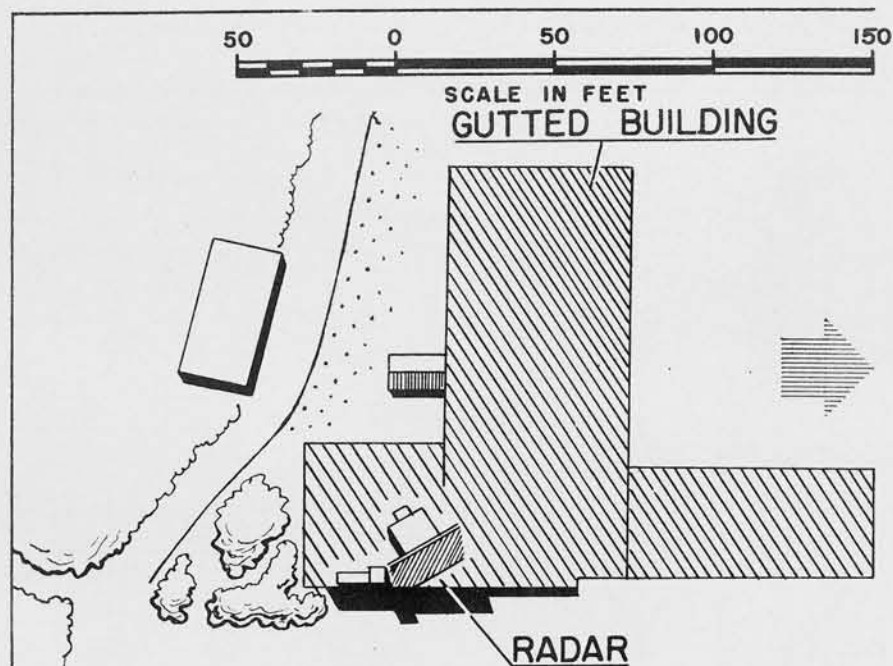


LOCATION . . . . . KWAJALEIN  
TYPE . . . (MARK I, MODEL I) . . . . "GUADALCANAL"  
ANTENNA . . . . . 26' x 18'  
FREQUENCY . . . . . 100 MCS  
P.R.F. . . . . 880 - 1200 . . . . PULSE . . 12 - 30  
MAXIMUM RANGE . . . . . 75 N. MI.

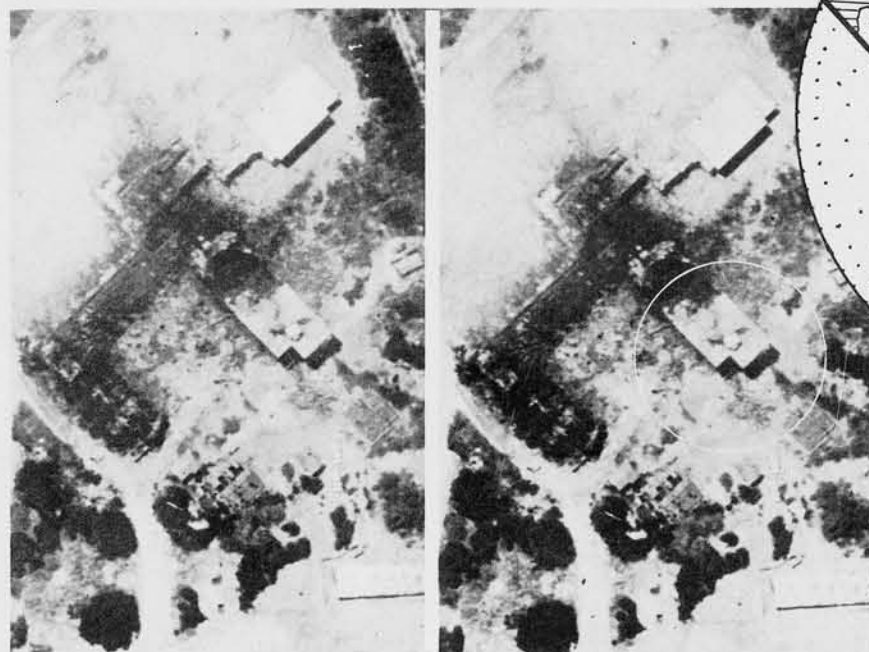


# RADAR

## GUAD. TYPE (CONT.)



LOCATION.....PEALE I., WAKE  
 TYPE.....(MARK I, MODEL I) GUADALCANAL  
 ANTENNA.....26' x 18'  
 FREQUENCY.....100 MCS  
 P.R.F.....880 - 1200 PULSE...12 - 30  
 MAXIMUM RANGE.....75 N. MI.

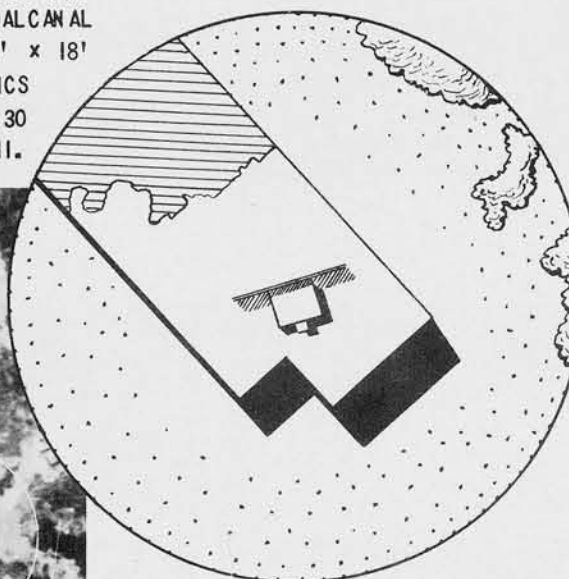


(NO PARALLAX)

PEALE ISLAND, WAKE



HEEL POINT, WAKE



LOCATION.....WOTJE  
 TYPE.....(MARK I, MODEL I) GUADALCANAL  
 ANTENNA.....26' x 18'  
 FREQUENCY.....100 MCS  
 P.R.F.....880 - 1200 PULSE...12 - 30  
 MAXIMUM RANGE.....75 N. MI.



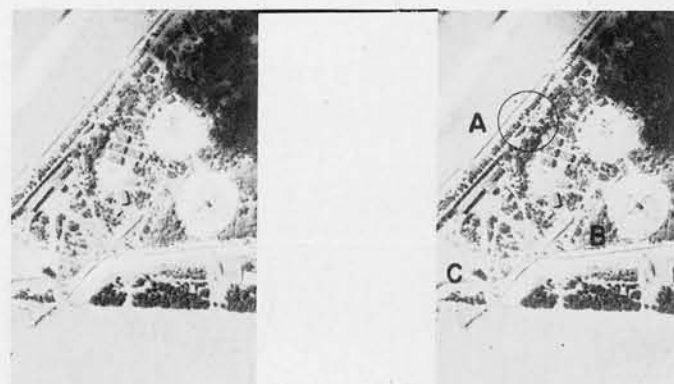
LOCATION.....HEEL PT., WAKE  
 TYPE.....(MARK I, MODEL I) "GUADALCANAL"  
 ANTENNA.....26' x 18'  
 FREQUENCY.....100 MCS  
 P.R.F.....880 - 1200 PULSE...12 - 30  
 MAXIMUM RANGE.....75 N. MI.

On this page are shown three more localities having Guadalcanal type Radar, similar to those at Kiska and Kwajalein. On coral islands the required height for installation is sometimes obtained by mounting set atop existing buildings. Note particularly the small square appendage on back of control shack.

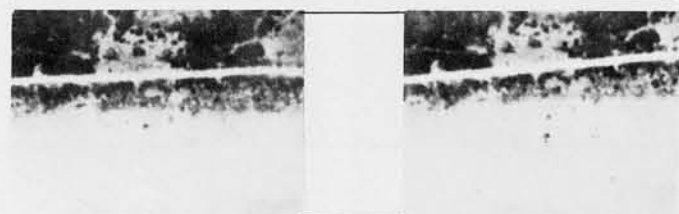
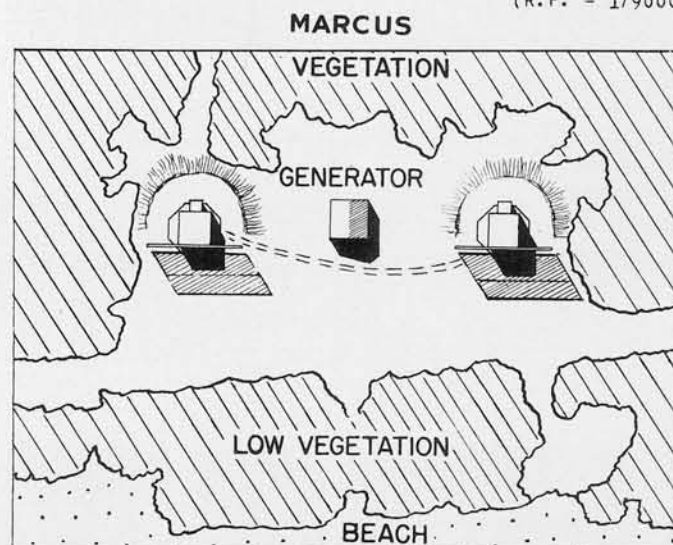
**CONFIDENTIAL**

# RADAR

## GUAD. TYPE (CONT.)



(R.F. - 1/9000)

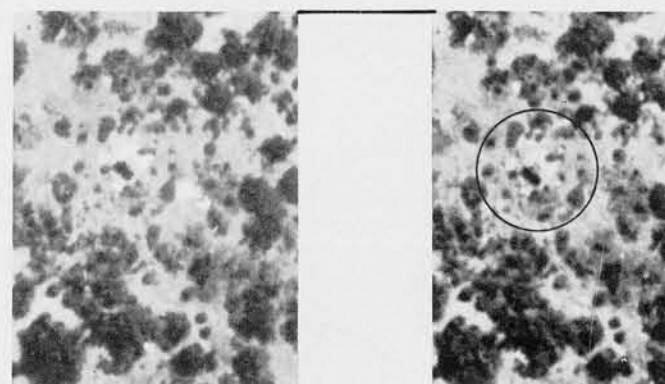


(R.F. - 1/4000)

LOCATION..... MARCUS  
TYPE..... (MARK I, MODEL I)..... "GUADALCANAL"  
ANTENNA..... 26' x 18'  
FREQUENCY..... 100 MCS  
P.R.F..... 880 - 1200..... PULSE... 12 - 30  
MAXIMUM RANGE..... 75 N. MI.

The above twin Radar installation at Marcus is located near the D. F. Station. The generator building is centrally located and is approximately 12 feet square.

In this case, one Radar may be used for search while the other tracks.



(R.F. - 1/3000)

LOCATION..... NAURU  
TYPE..... (MARK I, MODEL I)..... "GUADALCANAL"  
ANTENNA..... 26' x 18'  
FREQUENCY..... 100 MCS  
P.R.F..... 880 - 1200..... PULSE... 12 - 30  
MAXIMUM RANGE..... 75 N. MI.

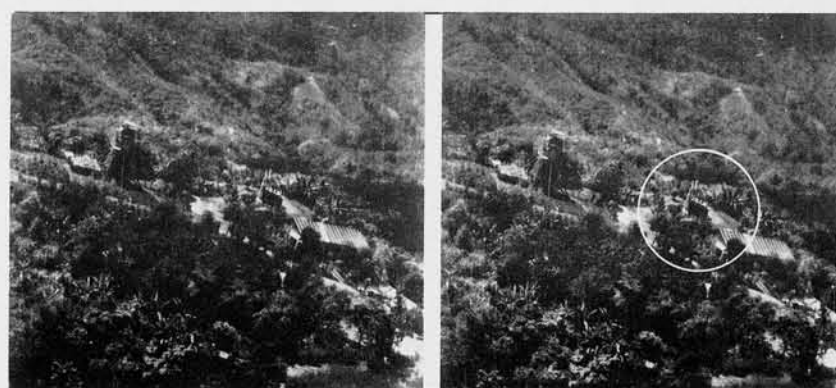
This installation at Nauru was once thought to have had a parabolic screen. However, it is now believed that the equipment functions in a similar manner and at the same frequency as the "Guadalcanal" type.

Previously, this set was shown as an example of a separate type of Japanese Radar, called "Nauru type". However in light of present information it seems more fitting to include it under Guadalcanal type.

This submarine photo of Shikoku, Japan, shows the faint outlines of a screen which is probably the Guadalcanal type radar. Identification cannot usually be based on such meager information, however. (Below)



SHIKOKU, JAPAN



LOCATION..... RABAUL  
TYPE..... (MARK I, MODEL I)..... "GUADALCANAL"  
ANTENNA..... 26' x 18'  
FREQUENCY..... 100 MCS  
P.R.F..... 880 - 1200..... PULSE... 12 - 30  
MAXIMUM RANGE..... 75 N. MI.

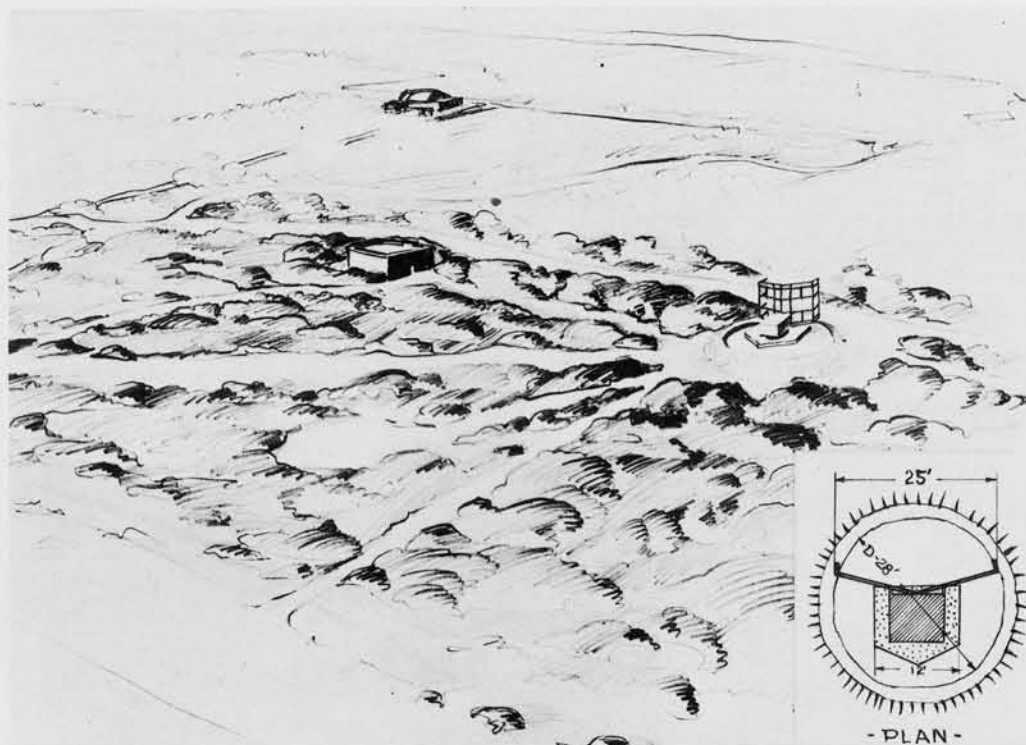
At the present date it is more likely that the Mobile Mattress, Attu, and other new types will be found in greater numbers than the Guadalcanal type.

The Stereo oblique to the left is a remarkably clear example of the "Guadalcanal" type. Note the projection of rows of dipoles from the front of the screen, which is two-dimensional and does not have a box-like character such as may be observed in "Attu" type shown on other pages later in this section. The flat roof on the control shack is characteristic of the Guadalcanal type. Note also that clearing of surrounding vegetation is not necessary for operation of this Radar.

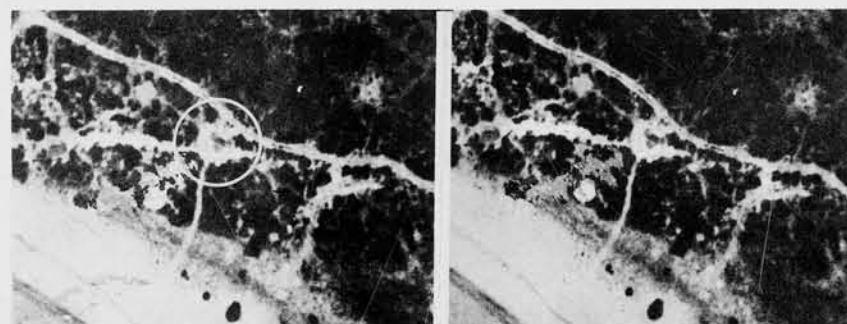


# RADAR

## GUAD. TYPE (CONT.)



The Kuku Point Radar is apparently a slightly different version of the Guadalcanal type. The bend as shown in the artist's drawing is approximately 25 degrees from a straight line. The low revetment suggests Kiska installations but is much smaller in diameter.



LOCATION . . . . . KUKU PT., WAKE  
 TYPE . . . . . (MARK I, MODEL I) . . . . . "GUADALCANAL"  
 ANTENNA . . . . . 26' x 18'  
 FREQUENCY . . . . . 100 MCS  
 P.R.F. . . . . 880 - 1200 . . . . . PULSE . . . . . 12 - 30  
 MAXIMUM RANGE . . . . . 75 N. MI.

**CONFIDENTIAL**



LOCATION . . . . . MALOELAP  
 TYPE . . . . . (MARK I, MODEL I) . . . . . "GUADALCANAL"  
 ANTENNA . . . . . 26' x 18'  
 FREQUENCY . . . . . 100 MCS  
 P.R.F. . . . . 880 - 1200 . . . . . PULSE . . . . . 12 - 30  
 MAXIMUM RANGE . . . . . 75 N. MI.



LOCATION . . . . . MALOELAP  
 TYPE . . . . . (MARK I, MODEL I) . . . . . "GUADALCANAL"  
 ANTENNA . . . . . 26' x 18'  
 FREQUENCY . . . . . 100 MCS  
 P.R.F. . . . . 880 - 1200 . . . . . PULSE . . . . . 12 - 30  
 MAXIMUM RANGE . . . . . 75 N. MI.

# RADAR

## ATTU TYPE

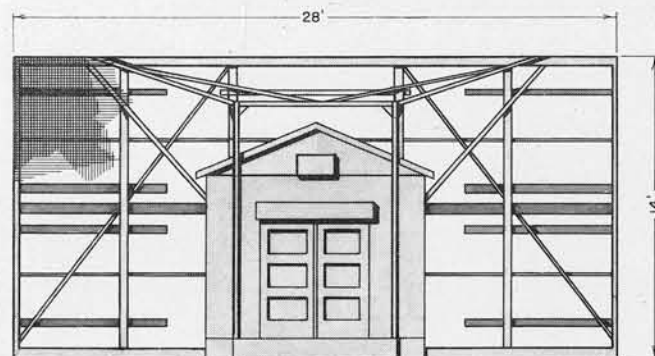
This radar, hereafter called the "Attu" type, was in an unassembled state when first found at Attu, Aleutians.

Electrically, it is very similar to the Guadalcanal type but is, in general, an improved modification. As of November 1944, it is still being used by the Japanese to a considerable extent in all areas.

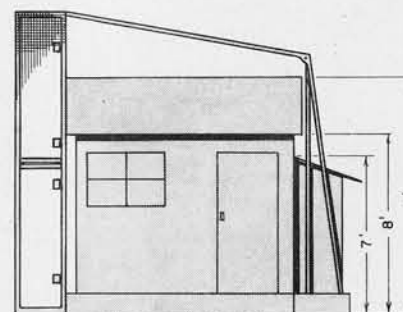
The most important identification factor, the box screen, is not present in these photos. Spotting of radar positions in aerial photos is largely dependent on screens and screen shadows. Below are shown drawings reconstructing the "Attu" type radar, shown on this and several following pages.



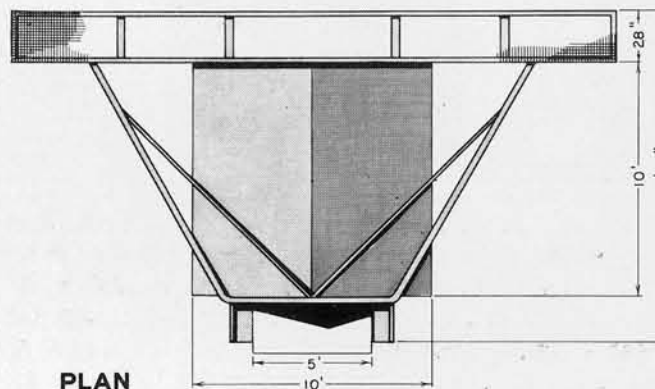
ATTU, ALEUTIANS



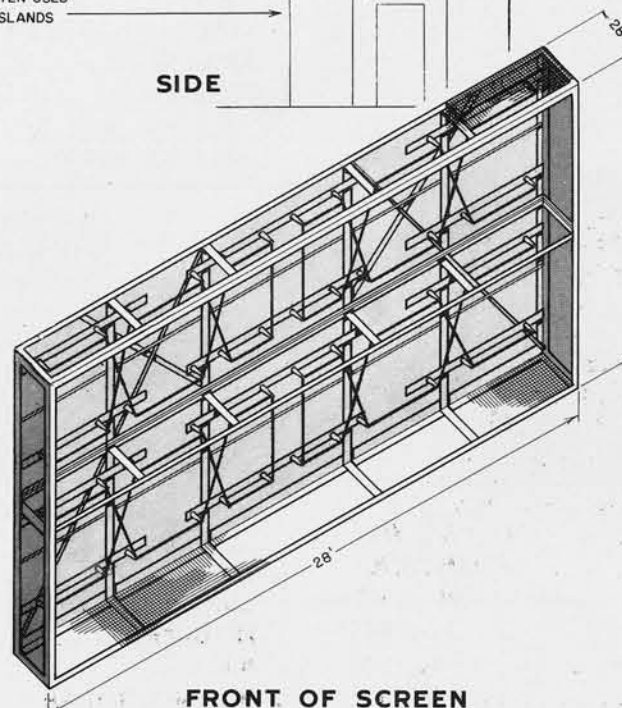
REAR



SIDE

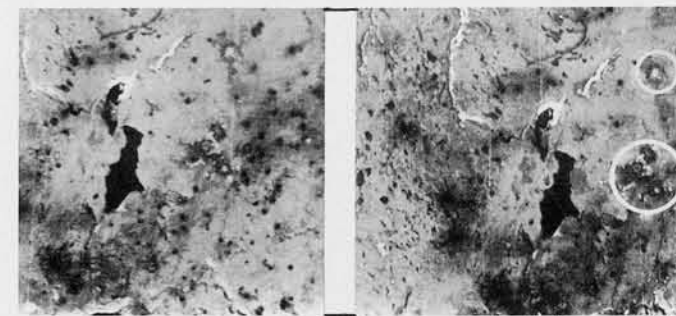


PLAN



FRONT OF SCREEN

CONCRETE BASE OFTEN USED  
ON LOW CORAL ISLANDS



ATTU, ALEUTIANS

(R.F. - 1/8000)

The first example found of the Attu type Radar was still in the process of construction. These views will illustrate the extreme difficulty of spotting radar without its best identifying characteristic -- the screen. Shown below is a well camouflaged generator house, also very difficult to detect in aerial photos.



LOCATION . . . . . ATTU  
TYPE (MARK I, MODEL I, MODIF. I) . . . . . "ATTU"  
ANTENNA . . . . . 28' x 14' x 2 1/3'  
FREQUENCY . . . . . 100 MCS  
P.R.F. . . . . 880 - 1200 . . . . . PULSE . . . . . 12 - 30  
MAXIMUM RANGE . . . . . 75 N. MI.



# RADAR

## ATTU TYPE (CONT.)



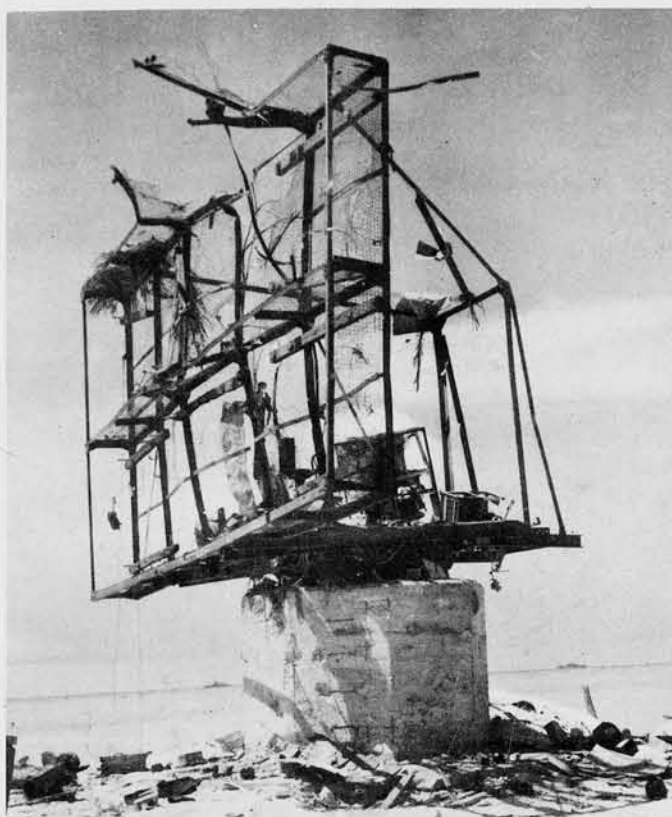
TARAWA, GILBERTS

ABOVE: Radar near east tip of Bititu

(R.F. - 1/2000)

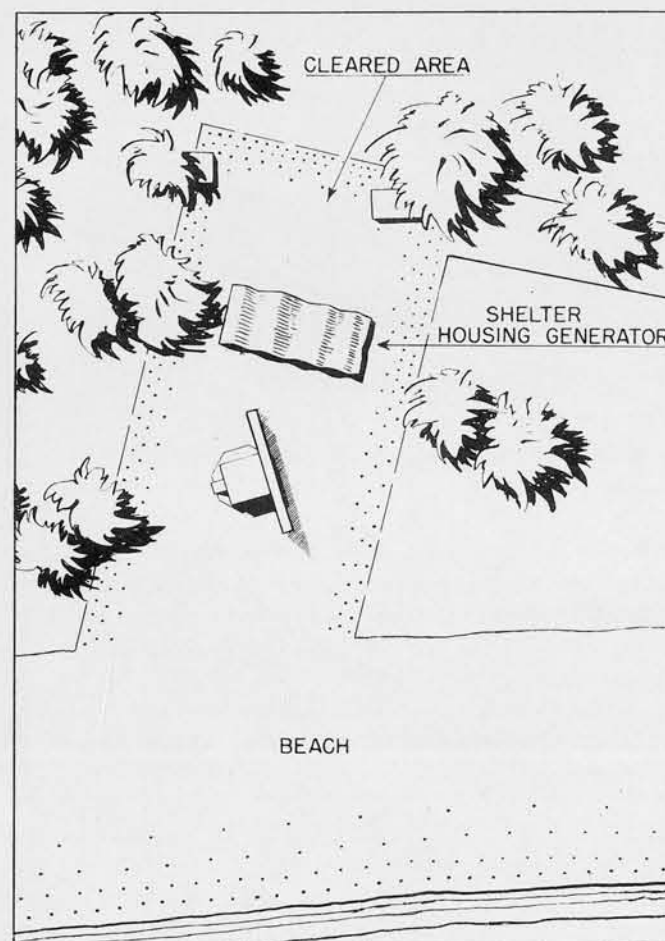


TARAWA, GILBERTS



TARAWA, GILBERTS

ABOVE: Note the horizontally elongated box-like shape of the screen of the ATTU type in contrast to the two dimensional more squared shape of the Guadalcanal type on previous pages.



TARAWA, GILBERTS



TARAWA, GILBERTS

ABOVE: Radar on west end of Bititu.

At Bititu Island, Tarawa Atoll were two Attu type radars of identical design. One was at the west end and the other a few hundred feet from the east tip. Both were set on high concrete bases and were used for different sectors of the air and surface search.

LOCATION.....	TARAWA
TYPE (MARK I, MODEL I, MODIF. I).....	"ATTU"
ANTENNA.....	28' x 14' x 2 1/3'
FREQUENCY.....	100 MCS
P.R.F. ....	820 - 1200
PULSE....	12 - 30
MAXIMUM RANGE.....	75 N. MI.

CONFIDENTIAL

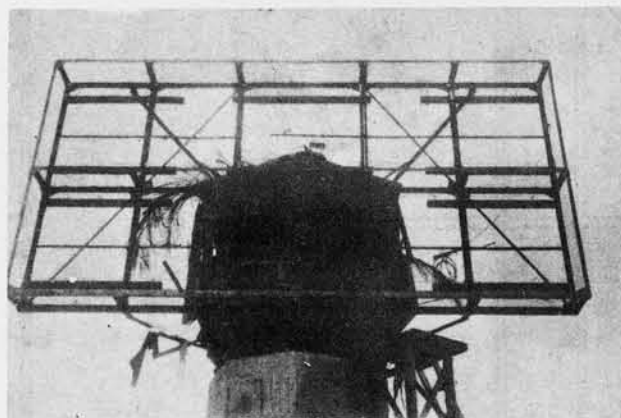
# RADAR

## ATTU TYPE (CONT.)

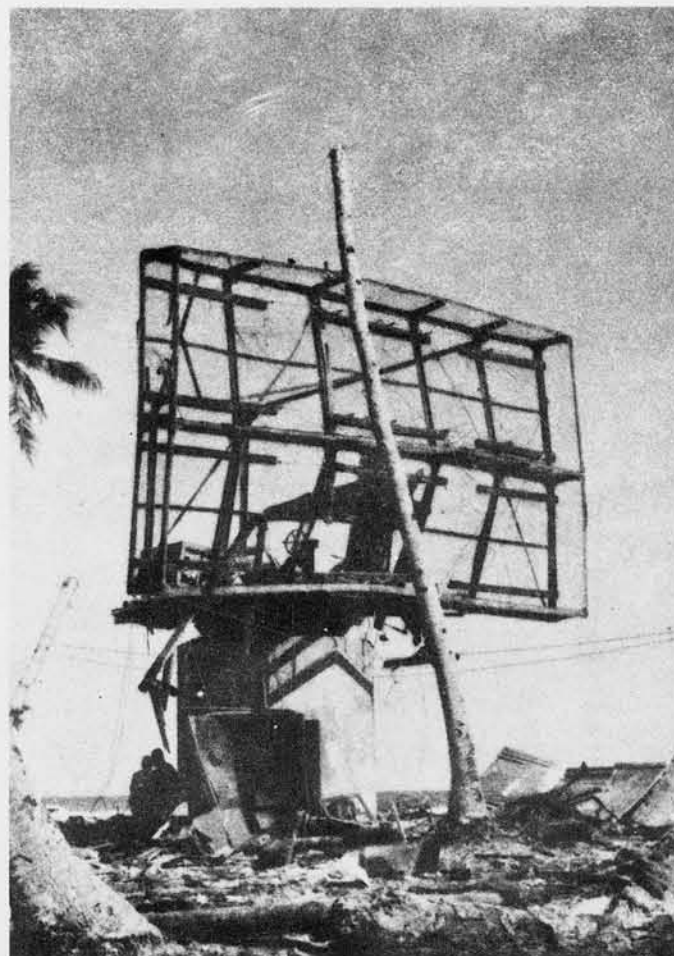


**MAKIN, GILBERTS**

ABOVE AND BELOW: Two views of Radar at end of Stone Pier. Concrete base is 18 feet high. Note pitched roof of "Attu" type.



**MAKIN, GILBERTS**



**MAKIN, GILBERTS**

ABOVE: Radar on South Coast. Concrete base is 8 feet high.

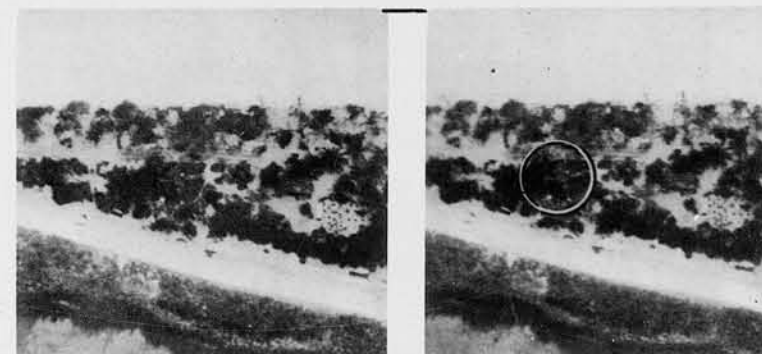
The two Radar installations on Makin are of the same design as at Tarawa and were installed in October 1943. The control shacks rotate with the screens on steel turntables to afford complete search coverage.

The high concrete bases afford greater range for surface search.

LOCATION . . . . .	MAKIN
TYPE (MK. I, MODEL I, MODIF. I) . . . . .	"ATTU"
ANTENNA . . . . .	28' x 14' x 2 1/3'
FREQUENCY . . . . .	100 MCS
P.R.F. . . . .	880 - 1200
PULSE . . . . .	12 - 30
MAXIMUM RANGE . . . . .	75 N. MI.

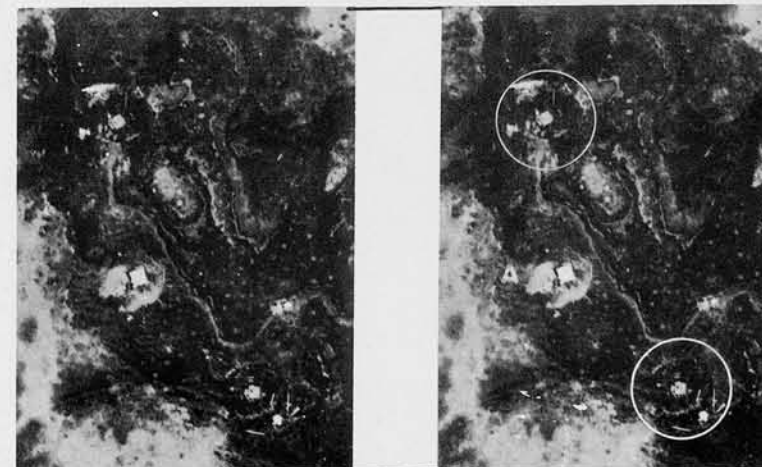


**MILLE, MARSHALLS**



**MILLE, MARSHALLS**

Same Radar on Mille, now cleared of vegetative camouflage.



(NO PARALLAX)

(R.F. - 1/3500)

**KAKUMABETSU WAN, PARAMUSHIRO**

LOCATION . . . . .	MILLE & PARAMUSHIRO
TYPE . . . . .	(MK. I, MODEL I, MODIF. I) "ATTU"
ANTENNA . . . . .	28' x 14' x 2 1/3'
FREQUENCY . . . . .	100 MCS
P.R.F. . . . .	880 - 1200
PULSE . . . . .	12 - 30
MAXIMUM RANGE . . . . .	75 N. MI.



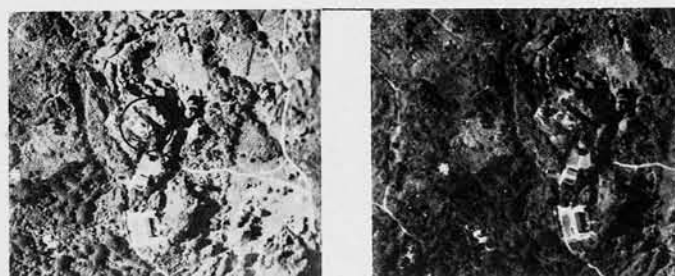
# RADAR

## ATTU TYPE (CONT.)

Numbers 1, 2, 3, 4, 5, and 6 on this page show the "Attu" type Radar at various scales for analytical study and comparison. The "Attu" type is widely used by the Japanese at present and its outward appearance in vertical photography is familiar to many interpreters. Although no information is available on the use of German equipment by the Japanese, a Small Wurzburg is shown here for further comparison in #4: "A"-Attu; "B"-Wurzburg.



LOCATION..... IWO JIMA  
TYPE. (MK I, MODEL I, MODIF. I)..... "ATTU"  
ANTENNA..... 28' x 14' x 2 1/3'  
FREQUENCY..... 100 MCS  
P.R.F..... 880 - 1200 PULSE..... 12 - 30  
MAXIMUM RANGE..... 75 N. MI.

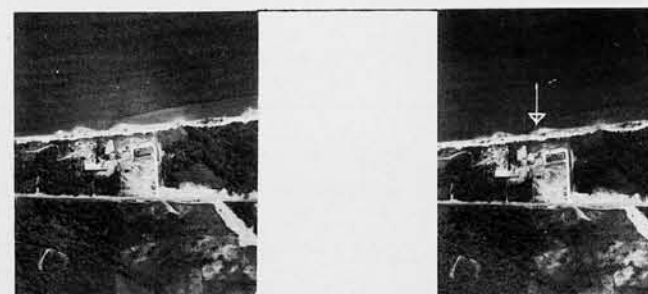


LOCATION..... OKAYAMA, FORMOSA  
TYPE. (MK. I, MODEL I, MODIF. I)..... "ATTU"  
ANTENNA..... 28' x 14' x 2 1/3'  
FREQUENCY..... 100 MCS  
P.R.F..... 880 - 1200 PULSE..... 12 - 30  
MAXIMUM RANGE..... 75 N. MI.

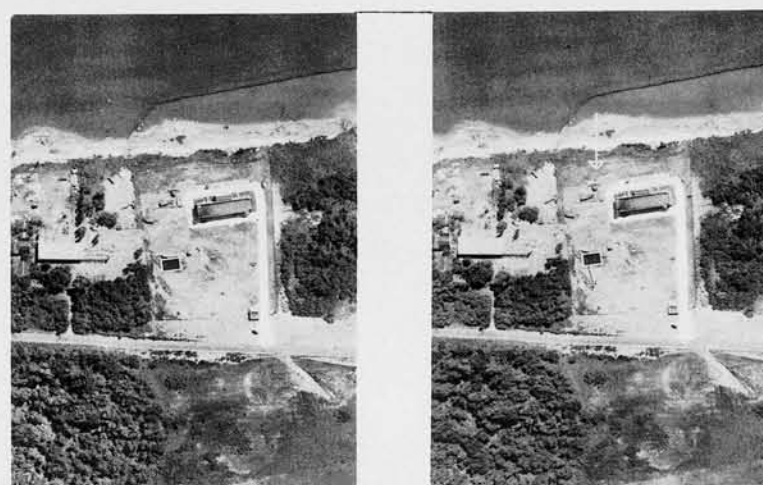
ABOVE: These two examples in the Kazans and on Formosa appear to be "Attu" type installations:

In both examples other related activities, such as communications, generating of power, and living and working quarters are present.

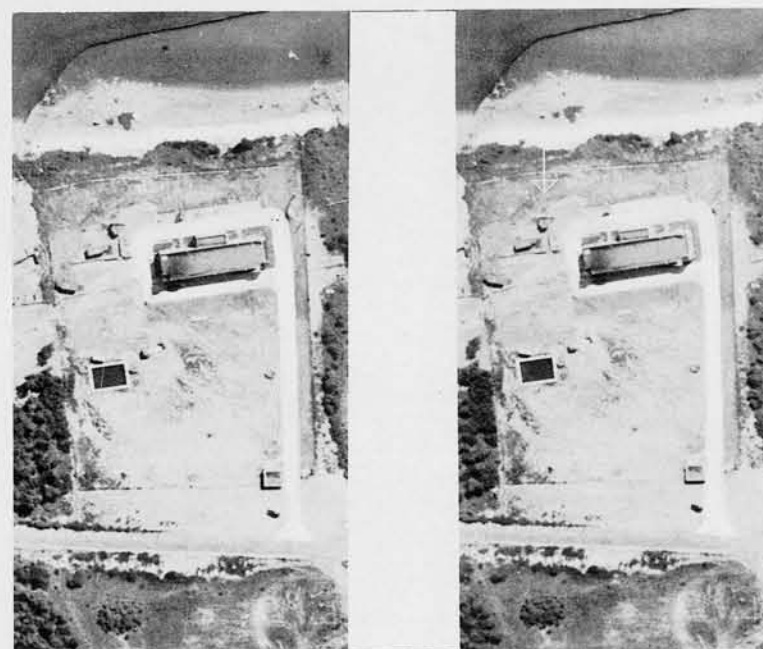
The Okayama set is 10 miles inland from the coast and both are situated on high points of land.



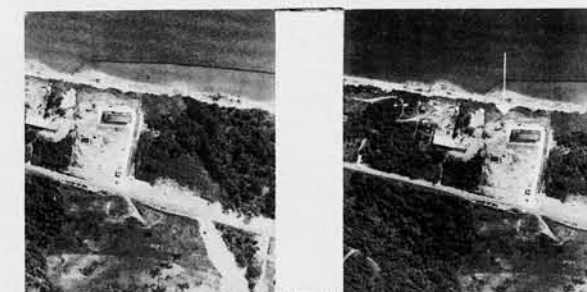
1 (R.F. - 1/15000)



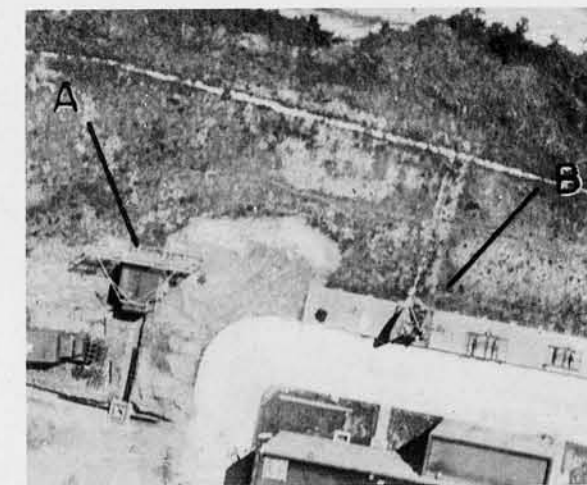
3 (R.F. - 1/5000)



5 (R.F. - 1/2600)



2 (R.F. - 1/10000)



4 (R.F. - 1/1000)



6 12" OBLIQUE AT 1000'

CONFIDENTIAL

# RADAR

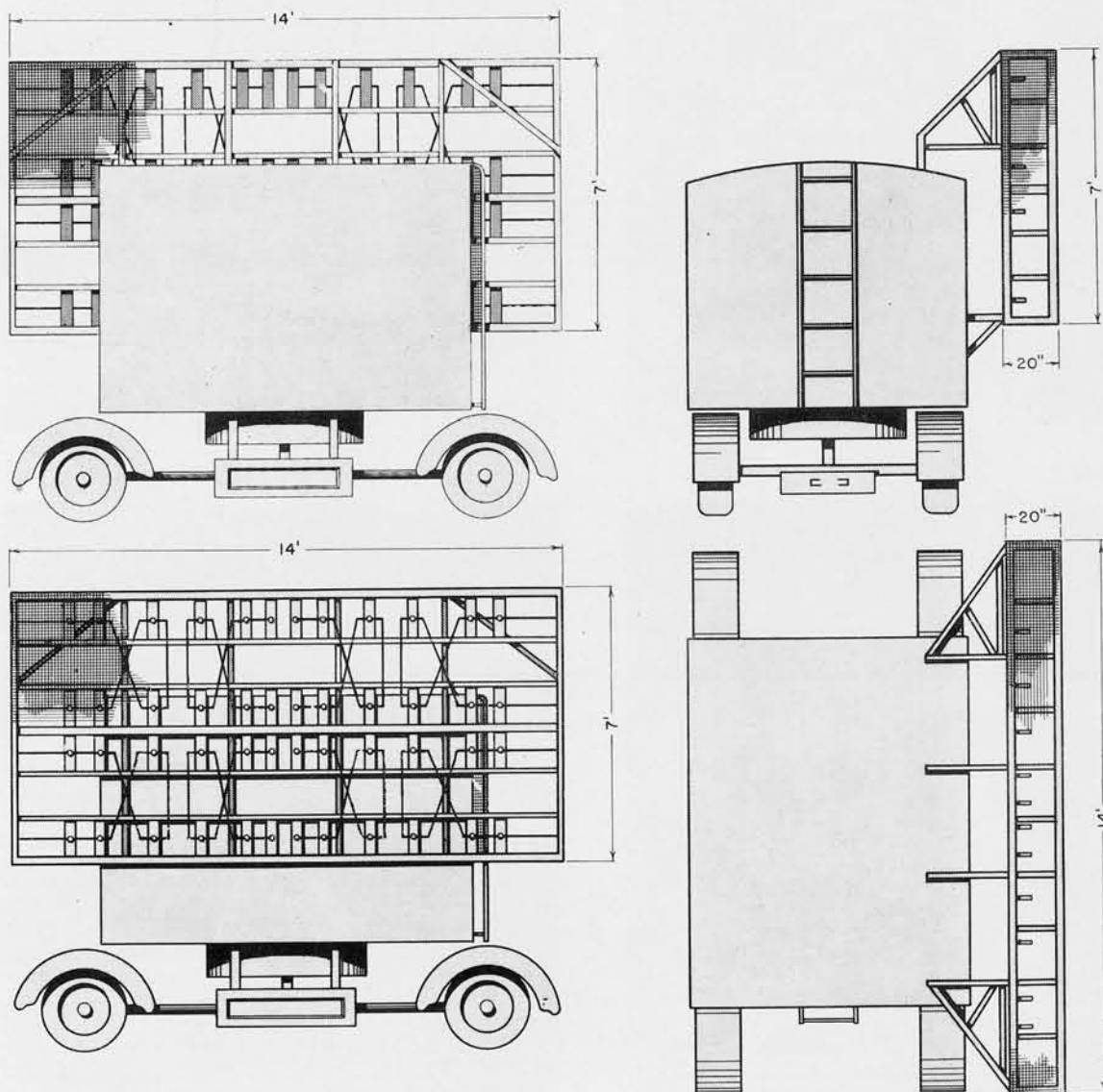
## MOBILE MATTRESS

A later, and apparently more efficient, Radar type is the "Mobile Mattress" or "Mark I, Model II". The Radar operates at 200 mcs. and is identified by a small screen (14' x 7') mounted on a Japanese standard army trailer (type 94).

This Radar is being used more and more for land-based search, either alone or in conjunction with older types. It is frequently seen mounted in emplacements, suggestive of a permanent siting.

Below are reconstructed drawings made from photos of the Kwajalein set.

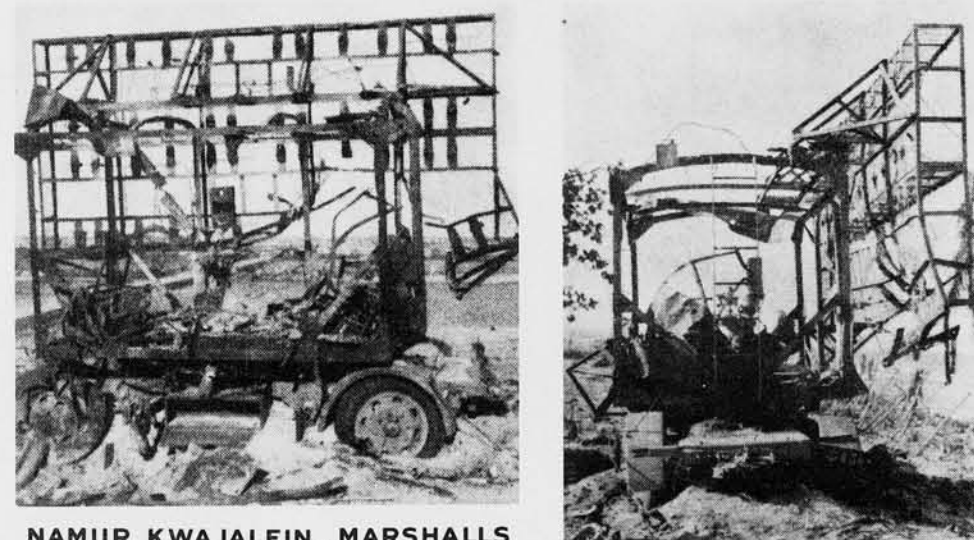
The shack, antennae, revolving mount and trailer may be separated for shipping purposes.



SHACK AND SCREEN ROTATE ON TURNABLE



NAMUR, KWAJALEIN, MARSHALLS



NAMUR, KWAJALEIN, MARSHALLS

LOCATION . . . . .	KWAJALEIN
TYPE . . . . . (MK. I, MODEL 2)	"MOBILE MATTRESS"
ANTENNA . . . . .	14' x 7' x 1 2/3'
FREQUENCY . . . . .	200 MCS
P.R.F. . . . . 800 - 1500	PULSE . . . . . 3 1/2 - 12
MAXIMUM RANGE . . . . .	100 N. MI.

The Mobile Mattress captured at Namur, Kwajalein, was mounted atop the standard concrete power house. Although the set is badly damaged, it is still possible to establish the important recognition features.

Note the similarity in design between this and the Attu type screen. The Mobile screen is much smaller, however.



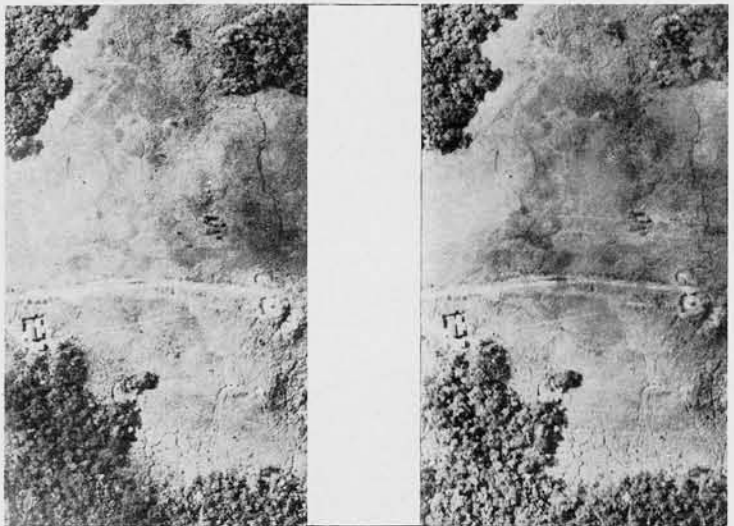
# RADAR

## MOBILE MATTRESS (CONT.)

Several additional views of the "Mobile Mattress" or Mark I, Model 2 are shown for familiarization. This set is very probably the best Japanese Search Radar in general use at present. The frequency is 200 megacycles per second and the maximum range is 100 nautical miles.

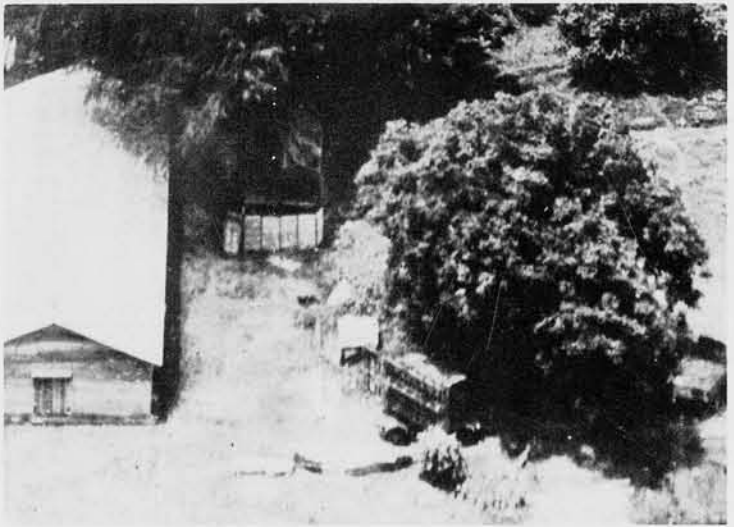


SATAWAN, CAROLINES



PONAPE, CAROLINES

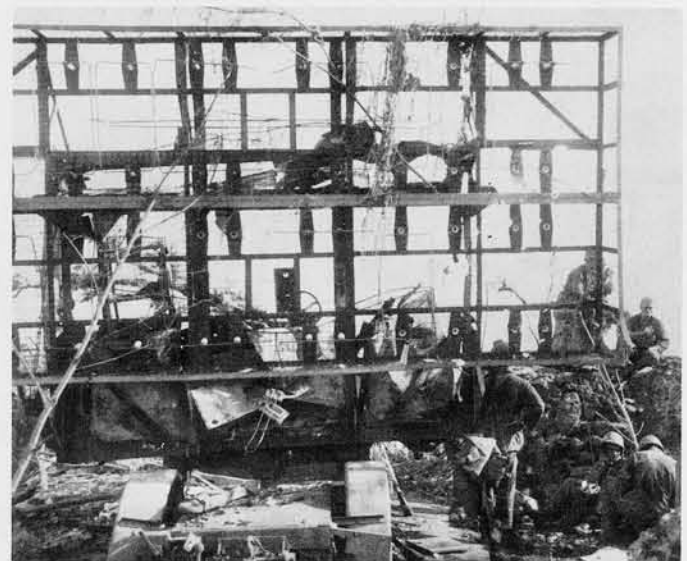
(R. F. - 14750)



RABAU, NEW BRITAIN



TINIAN, MARIANAS



TINIAN, MARIANAS



TINIAN, MARIANAS



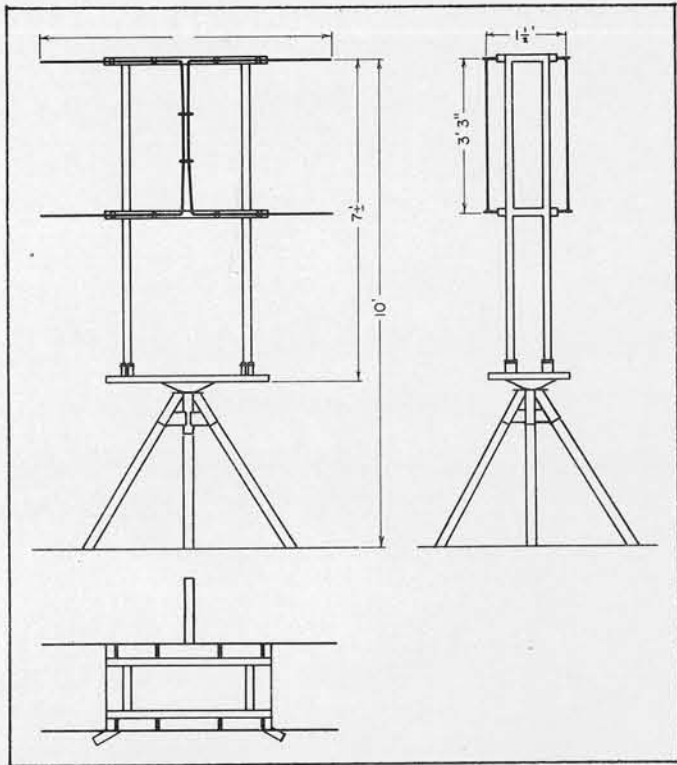
TINIAN, MARIANAS

CONFIDENTIAL

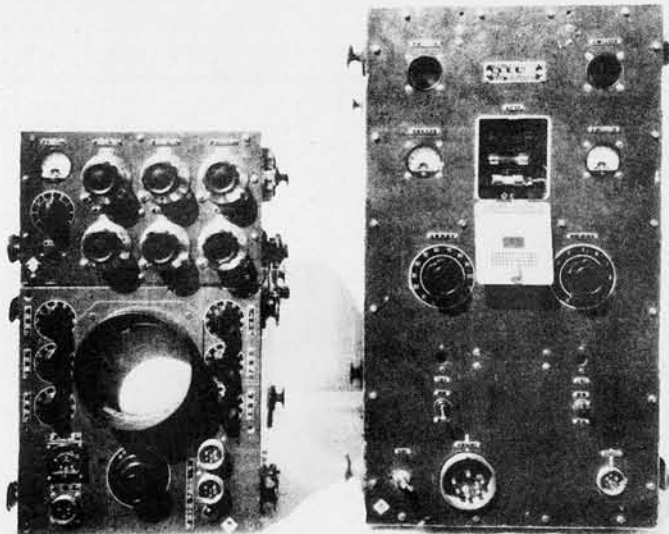
# RADAR

## PORTABLE TYPES

LOCATION . . . . . PORTABLE  
 TYPE . . (AIR MK 6 "SPECIAL") . . . "MARK 6 PORTABLE"  
 ANTENNA . . . . . DIPOLES  
 FREQUENCY . . . . . 150 MCS  
 P.R.F. . . . . 1000 . . . PULSE . . . . . 3-5  
 MAXIMUM RANGE . . . . . 30 N. MI.



MARK 6 PORTABLE



MARK 6 MODEL 4 EQUIPMENT



MARK 6 PORTABLE

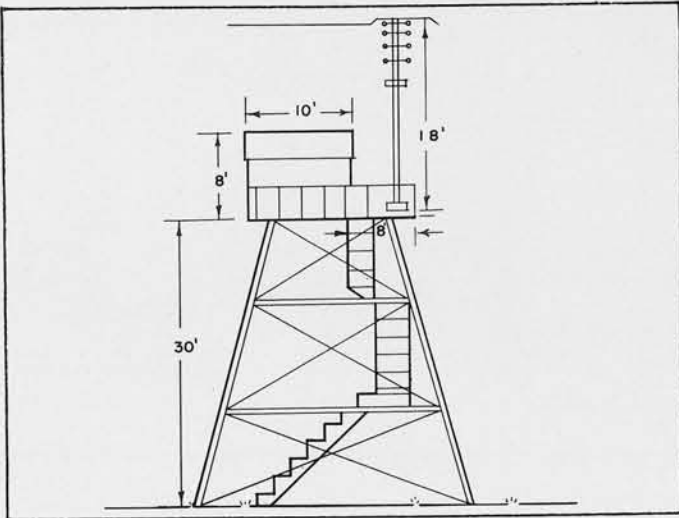
ABOVE AND LEFT COLUMN: This portable Radar ("Mark 6 Portable") is an adaptation of the same set used in aircraft for search (Mark 6, Model 4), and its characteristics are believed to be similar to the original airborne model. When in operation, the Radar gear, shown at lower left, rests on the lower shelf and the whole is supported by a collapsible tripod. The dipoles are approximately 7 feet long. This set was found on Guam.

RIGHT COLUMN: The "Mark 13 Portable", (temporary designation Mark 1, Model 3) is believed to be essentially the same set as the "Mark 6 Portable" with certain modifications including higher power and greater range. The mode of construction at the site may vary considerable with this Radar. The above ground shot shows improvised antenna at Saipan. At Goerango Point, Morotai, the antenna, all equipment and control shack were mounted on a tower 30 feet in height. Note that in both cases, however, the antenna consists of a stack of dipoles.



MARK 13 PORTABLE

LOCATION . . . . . PORTABLE  
 TYPE . . (MK 1, MODEL 3) . . . "MK 13 PORTABLE"  
 ANTENNA . . . . . 7' DIPOLES  
 FREQUENCY . . . . . 150 MCS  
 P.R.F. . . . . 500 . . . PULSE . . . . . 10  
 MAXIMUM RANGE . . . . . 45 N. MI.



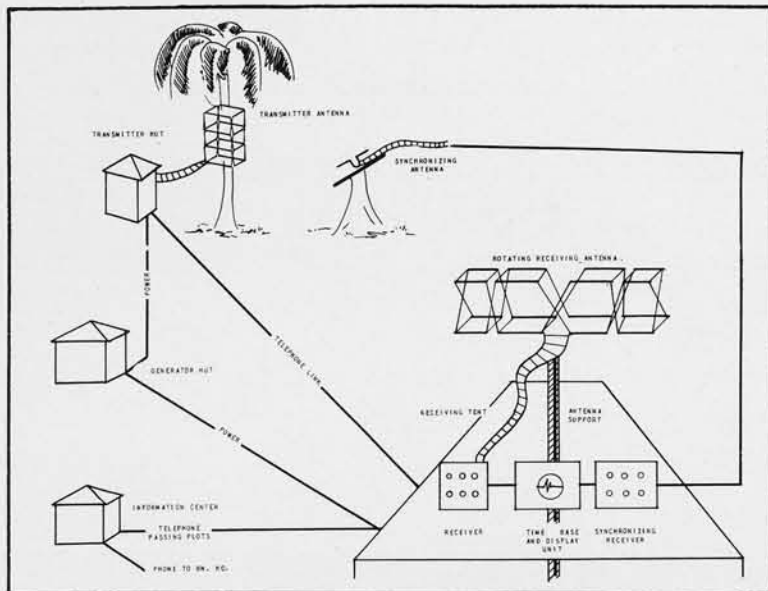
MARK 13 PORTABLE

CONFIDENTIAL



## RADAR

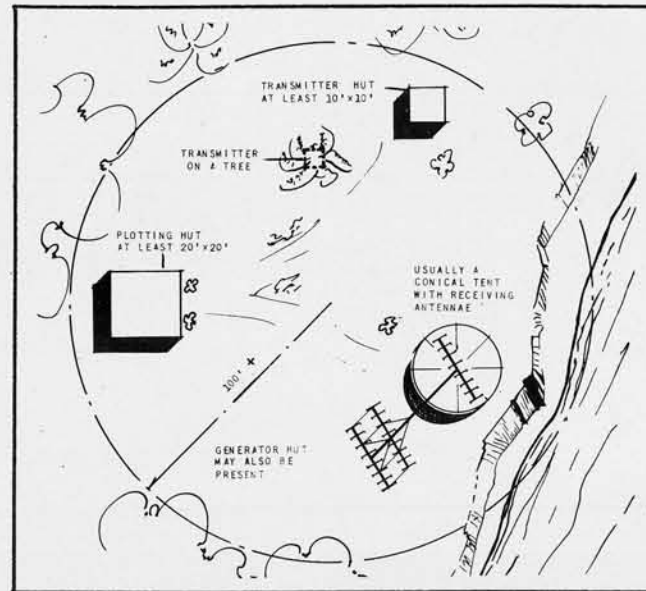
### PORTABLE TYPES



MARK 229 OR "CHI"



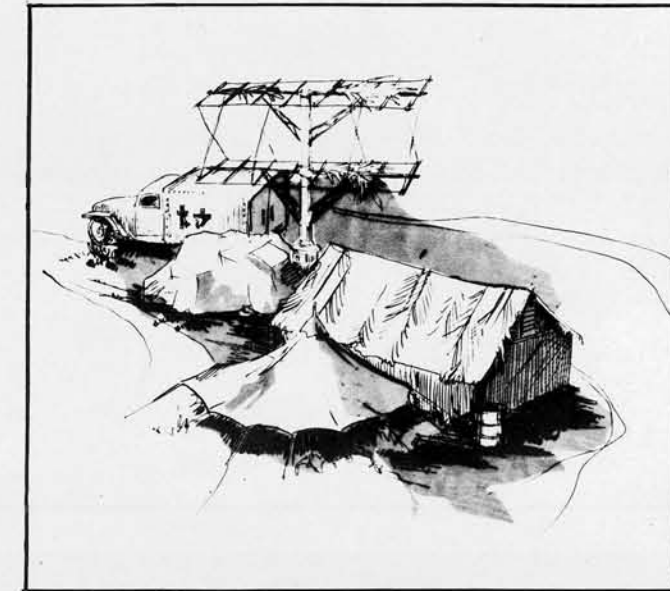
**WEWAK TYPE**



MARK 229 OR "CHI"



**WEWAK TYPE**



**WEWAK TYPE**

Information on the exact designations, characteristics and use of the 70 megacycle Radars are not entirely clear at this time. However, they may be reasonably broken down into two main subdivisions:

- (1) A transportable (possibly mobile) type which was first seen at Wewak in 1943 and which has been called the "Wewak" type or "Ya"

- (2) A type which may be transportable but entails the use of a separated small non-directional transmitter which is fixed (often attached to the trunk of a tree under the foliage). This type is known as "Chi" or Mark 229.

TYPE . . . . .	( "YA" )	"WEWAK "
ANTENNA . . . . .		20' x 7' x 4'
FREQUENCY . . . . .		70 MCS
P.R.F. . . . .	750	PULSE . . . . . 25 - 35
MAXIMUM RANGE . . . . .		125 N. MI.

The best recognition feature for the 70 megacycle Radars is the 20' array set on top of a pole. Rough dimensions are as follows: Overall length of row of dipoles - 20'; length of dipoles - 7'; vertical separation between rows of dipoles - 7'; overall height above ground - 25'. The entire shaft and dipoles rotate.

This equipment has the greatest range of most known Japanese Radars now in production and undoubtedly enjoys wide useage in certain areas for early warning purposes. It possesses the advantages of being transportable and is easily camouflaged.

TYPE . . . . .	(MK 229)	"CH1"
ANTENNA . . . . .		20' x 7 1/4' x
FREQUENCY . . . . .		70 MCS
P.R.F. . . . .	750	PULSE 25 - 35
MAXIMUM RANGE . . . . .		125 N. MI.

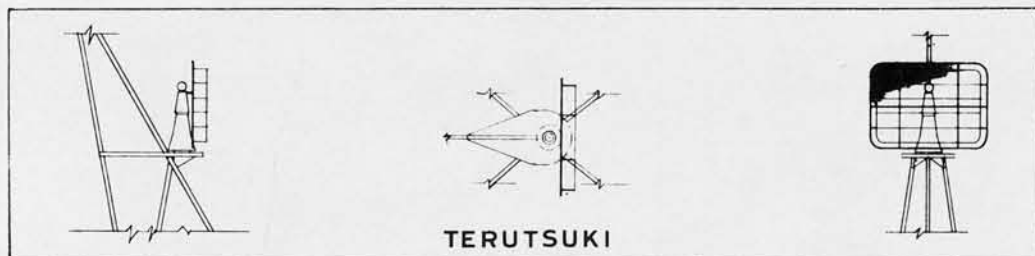
~~CONFIDENTIAL~~

# RADAR

## SHIP BORNE TYPES



NATCHI CA



SIDE

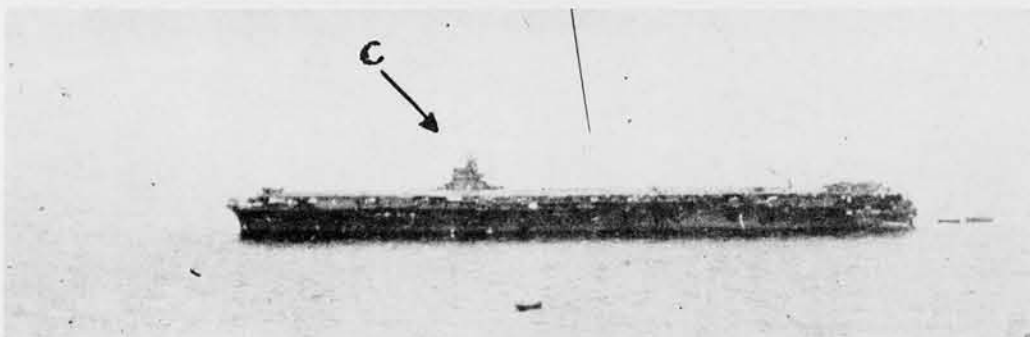
PLAN

FRONT

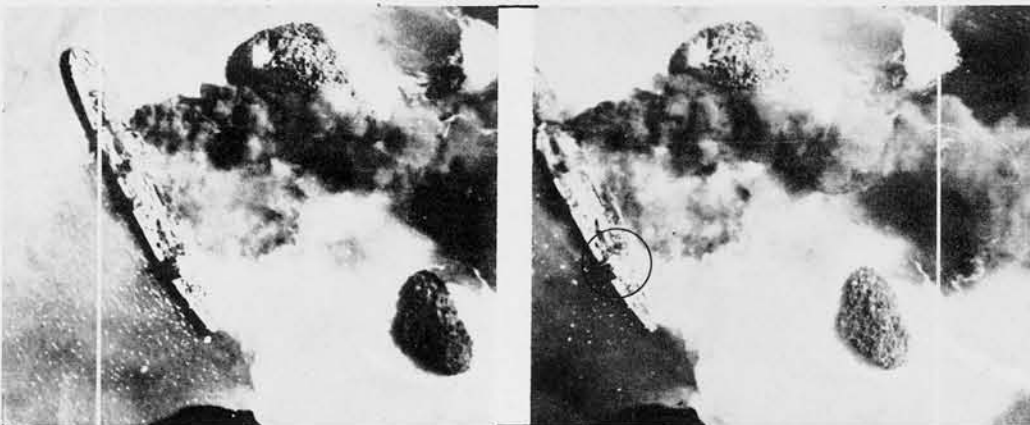
TERUTSUKI



TERUTSUKI DD



SHOKAKU CV



NAVAL TENDER

There are two basic Radar types in use by the Japanese Navy afloat at the present time. One is a 200 Mcs. search Radar with a mattress type antenna, the other is a 3000 Mcs. Radar for surface search and surface fire control, using electromagnetic horns. (A 150 mcs. Search Radar has been reported)

Search Radar has been photographed many times on Japanese naval vessels and is usually located at the highest point of the ship, except on aircraft carriers, where there are two sets. This search Radar is Mark 2, Model 1 or "Ship Mattress" and is designed primarily for early warning against planes.

LOCATION . . . . . SHIPBORNE  
TYPE . . . . (MOST ARE MARK 2, MODEL 1) . . . . . "SHIP MATTRESS"  
ANTENNA . . . . . 14' x 7' x 1.67'  
FREQUENCY . . . . . 200 MCS  
P.R.F. . . . . 1000 . . . . . PULSE . . . . . 10  
MAXIMUM RANGE . . . . . 100 N. MI.



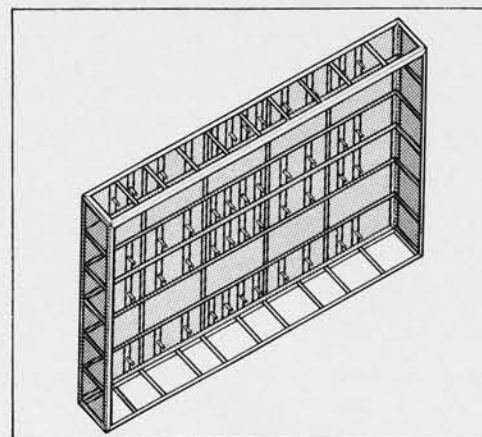
TAIHO CV

"A" - Two Mark 2, Model 1 antennae, one mounted forward and the other abaft the island of the CV "Taiho", new Japanese carrier.

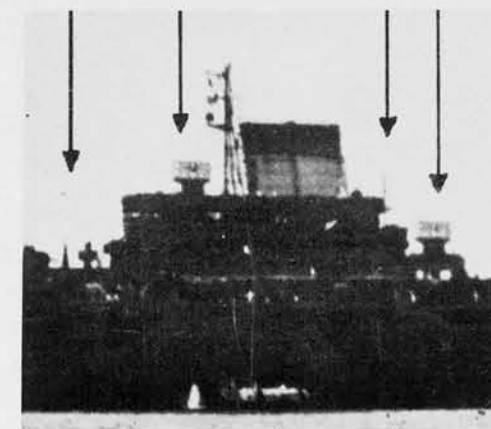
"B" - Two Medium Frequency Loop Type Direction Finders.

"C" - Mark 2, Model 1 antenna mounted on top of the island superstructure of the CV Shokaku. (See left)

The "Ship Mattress" or Mark 2, Model 1 antenna (see drawing below) is thought to be almost identical to that of the "Mobile Mattress", a land based Radar. This type is believed to be the most widely used, at present, for shipborne air warning equipment.



SHIP MATTRESS ANTENNA



CV TAIHO, DETAIL OF ISLAND



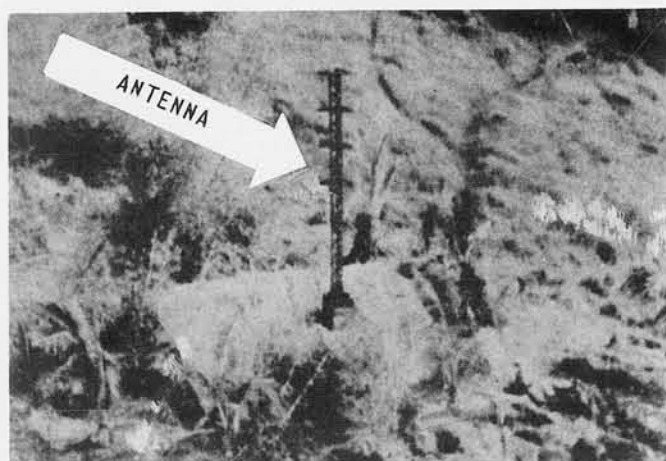
# RADAR

## SHIP BORNE TYPES

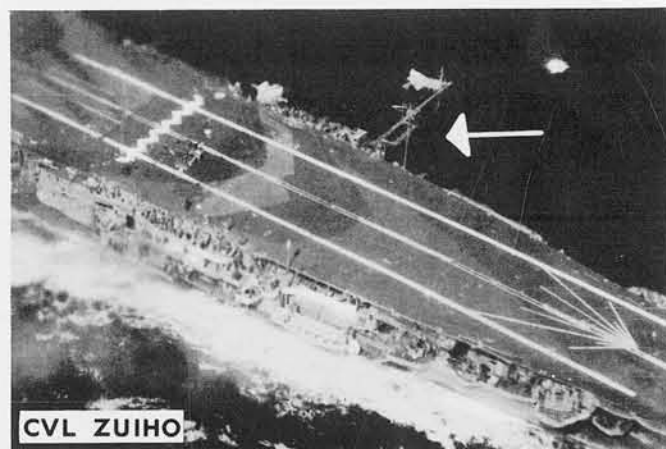
1 APRIL 1945

"LADDER TYPE" ship borne air search radar has been observed on the CVL Zuiho, CA Nachi Class, CA Atago Class, and on Terutsuki, Shimakaze, Takanami, and Fubuki (Amagiri Group) Class destroyers. This set is thought to be the ship borne adaptation of the land-based Mark 1 Model 3 radar, operating on 145--175 Mcs., and is reportedly designated Mark 2 Model 4 by the Japanese. The "LADDER TYPE" is mounted on the mainmast of the destroyers pictured, a factor which appears to limit the effectiveness of search astern. Photographs of Terutsuki Class DD's reveal the "LADDER TYPE" in addition to the "MATTRESS TYPE" carried on the foremast.

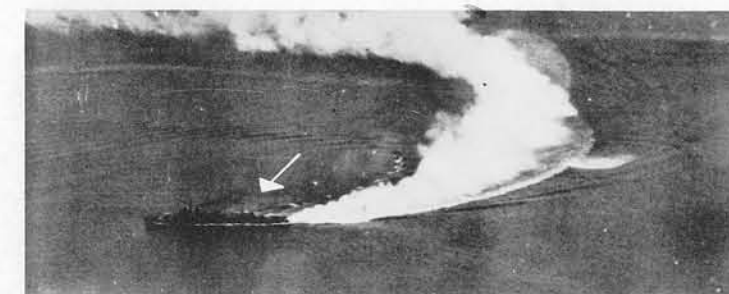
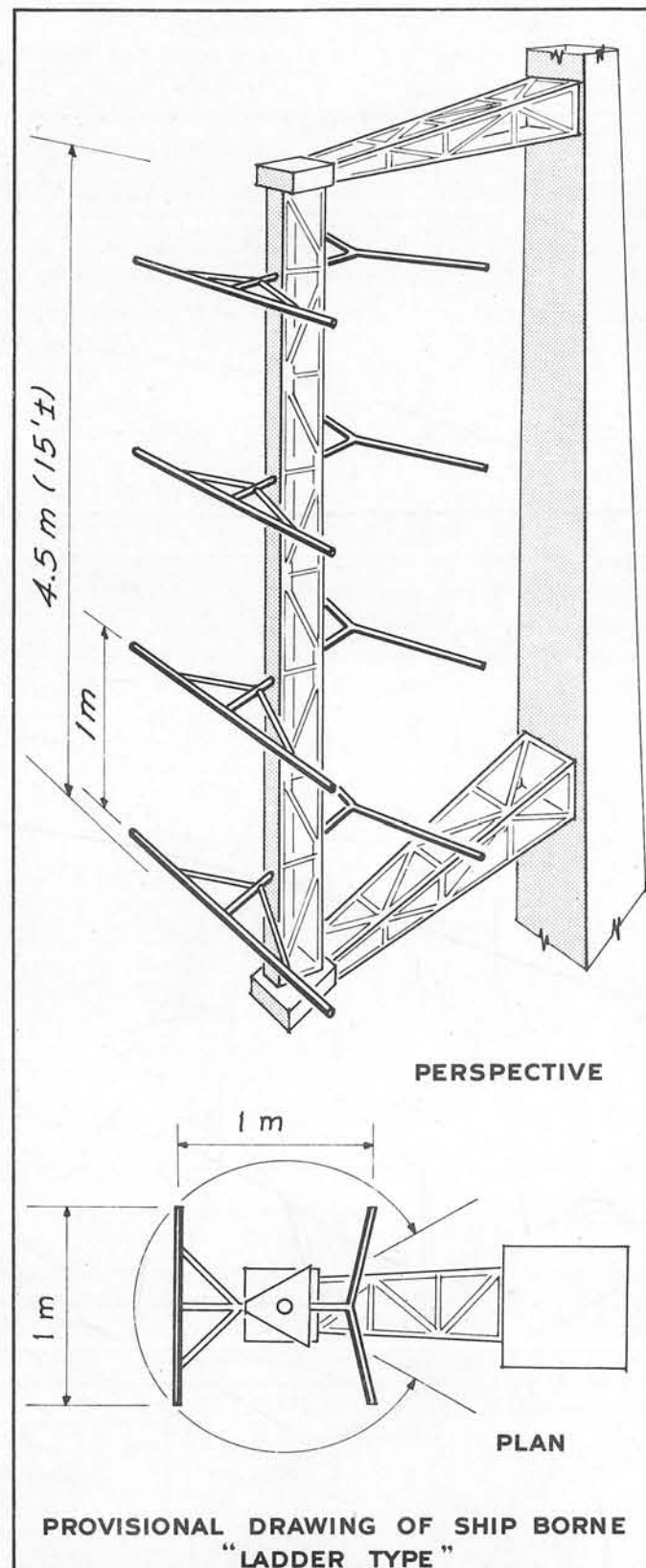
LOCATION . . . . . "SHIP BORNE"  
TYPE (Probably Mk. 1, Mod. 3 adaption) "LADDER TYPE"  
ANTENNA . . . . . 1 meter DIPOLES  
FREQUENCY . . . . . 150 Mcs.  
P.R.F. . . . . 500 . . . . . PULSE . . . . . 10  
MAXIMUM RANGE . . . . . 60 N. MI.



LAND BASED MK.1 MOD.3



CVL ZUIHO



DD TAKANAMI CLASS



DD TAKANAMI CLASS



DD SHIMAKAZE CLASS



CVL ZUIHO

CONFIDENTIAL

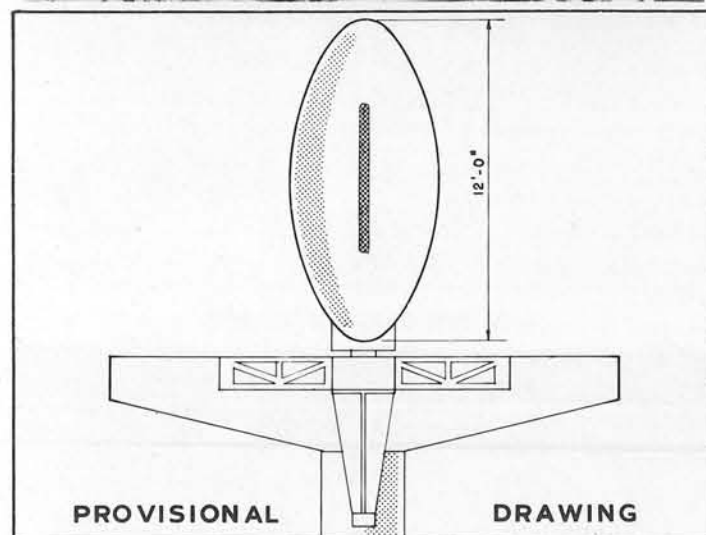
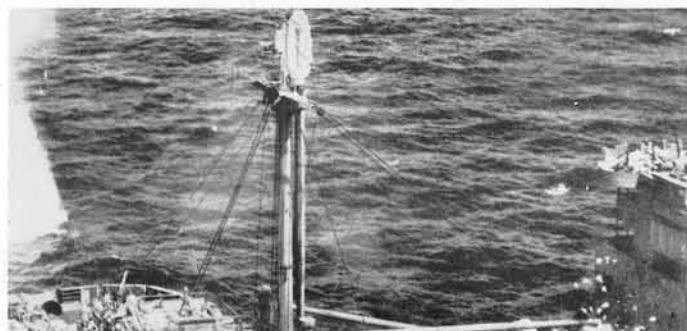
# RADAR

## SHIP BORNE TYPES

1 APRIL 1945

### SUSPECTED NEW TYPE SHIP BORNE RADAR

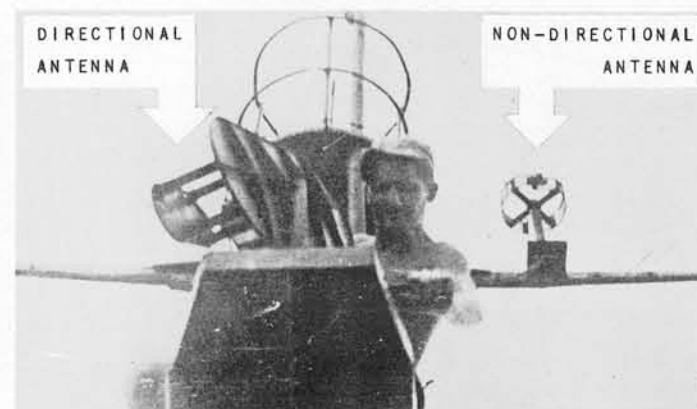
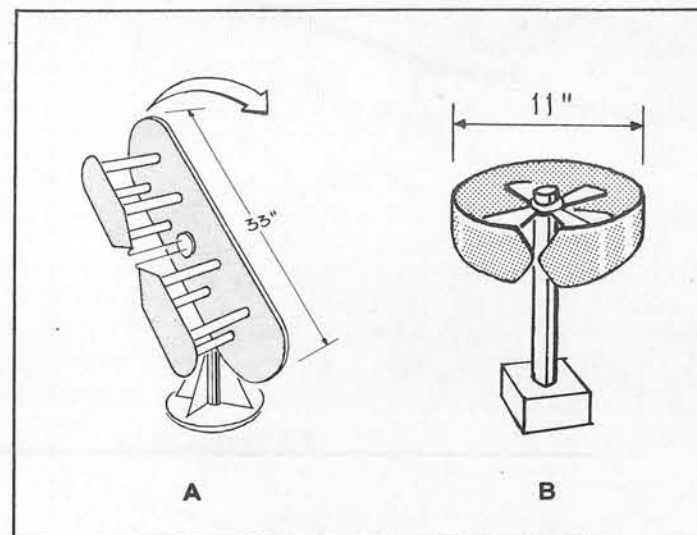
Suspected Mark 2 Model 3 ship borne radar antennae were observed on the foremast and mainmast of a Type B special amphibious ship, the Takatsu Maru. A canvas covering which appears to be on the foremast antenna precludes detailed interpretation. POW reports and captured documents indicate use of a paraboloid ship borne search and fire-control radar designated Mark 2 Model 3 and operating on 517 Mcs.



### RADAR SEARCH RECEIVER

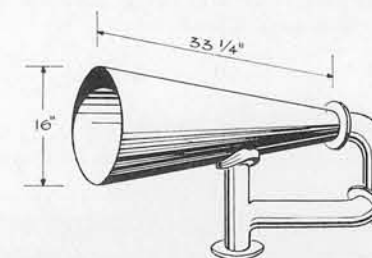
Radar Search Receiver (or Detector) gear has been recovered from several Japanese vessels sunk off Leyte. This apparatus receives transmitted radar waves and has been used by the Japanese for interception of our radar transmissions, thereby serving as an "early-warning" device.

The RSR antennae recovered were of two types: (a) Directional (rotating antenna) mounted on a small pedestal fitted to the foremast slightly above the bridge; and (b) Non-directional (non-rotating antenna) mounted on the forward yardarm. Two sizes of Directional antennae were found: a large type (22" wide x 54" long) made of wire mesh; and two small types (12" x 33" long), one made of wire mesh and the other constructed of a solid metal plate (see (A) below). Both large and small Directional antennae were of the same shape. The Non-directional antennae were constructed of wire mesh and measured 11" in diameter.



### MK. 2 MOD. 2 MODIF. 4 RADAR

A "Two-Horn" surface search radar was recovered from a sunken APD in San Isidro Bay, Leyte. The horns are of identical shape and size and were mounted on a square steel tower secured on the after part of the bridge immediately forward of the foremast. The horns are geared to rotate in synchronism and apparently can be turned manually or electrically. The name plate on the set indicated this to be a temporarily designated Mark 2 Model 2 Modification 4 Radar.





**RADAR**  
**SHIP BORNE TYPES**

Drawings of the Electromagnetic horn antennae of the Mark 2, Model 2 Radar are shown on this page.

The Japanese have met with many difficulties in the early development of this "micro-wave" set. Nevertheless, it is now believed to be functioning in a satisfactory manner. P.O.W.'s have reported that it is now used widely throughout the fleet with good results. In that the information on which these drawings were based (lower right) is now over a year old, changes in appearance are quite possible.

However, the configuration will undoubtedly consist of horns similar to the drawings shown on this page. The horn dimensions and the design of the turntable may vary somewhat.

Excerpt from a captured Japanese notebook, probably written from class lecture early in 1944, presents the Japanese problem in Naval Radar. The lecturer is discussing the use and development of Mark 2 Model 1, "Ship Mattress" Radar.

"However it was immediately apparent that it would be difficult to use the set for fire control since this would require range and bearing accuracy beyond the scope of a set designed primarily as a warning device. Nevertheless, the exigencies of war demanded that this set be used for other purposes than those of a mere warning device. Since the set was to be used for fire control, the improvement of range and bearing accuracy was given top priority and the present supplementary equipment was placed in trial production. With the addition of this equipment, the expected results were obtained, but though its sensitivity was enough for a set designed primarily as a warning device, it was still not accurate enough for effective fire control making fullest use of measurement data. It is hoped that great improvements in performance may be expected with the early production of radar designed solely for fire control. (ED: Probably Mk. 2, Model 2, Modif. 12)

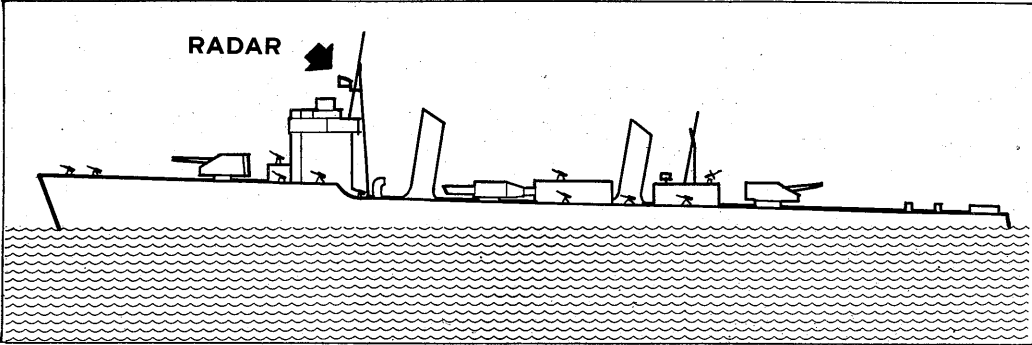
But in the present stage of the war we must get the most out of our present equipment, and not vainly discuss the possibilities for the future. Various methods of dealing with this problem are now under study."

Recent P.O.W. information indicates that many types of Naval Vessels are now equipped with Mark 2, Model 2 and modifications. Knowledge of the present status and performance of the equipment is still somewhat hazy, but interpreters should examine all ships for presence of electro-magnetic horns.

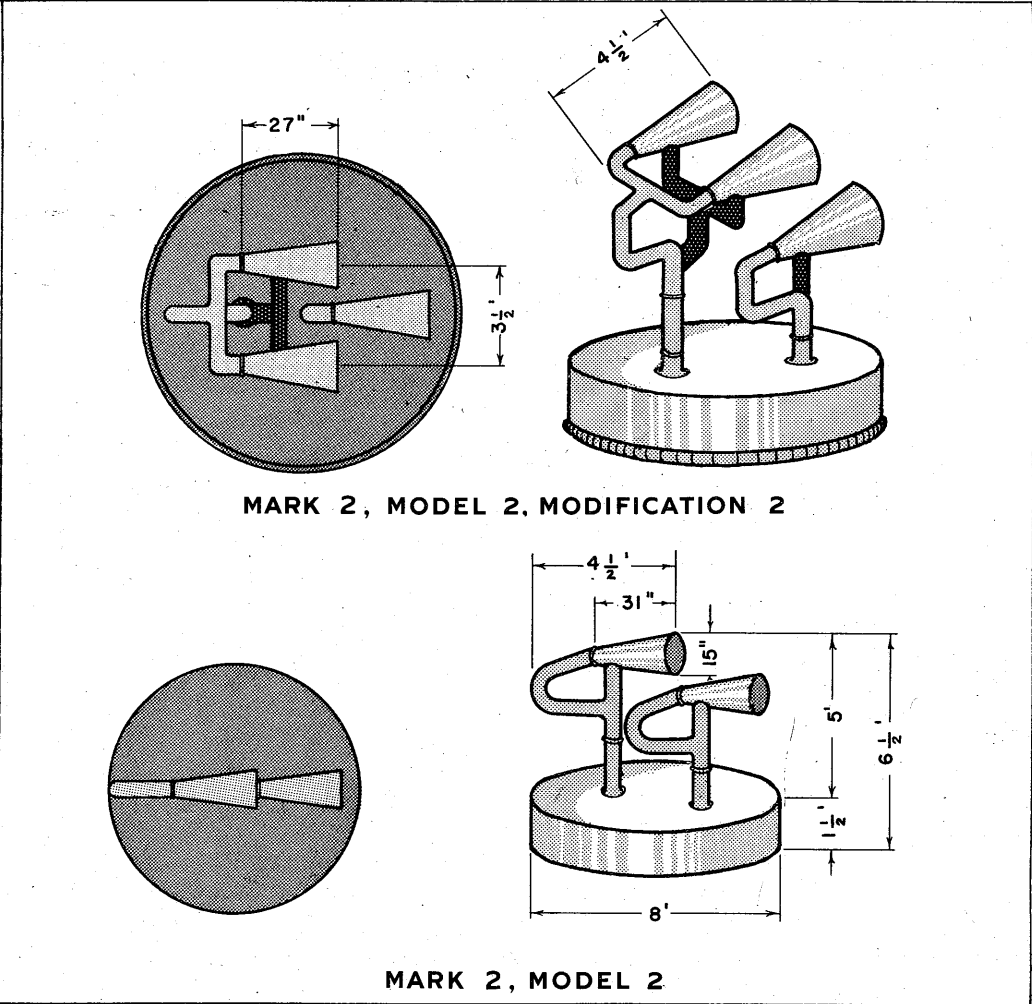
In most vessels, the likely location for the horns is near the top of the foremast or forward superstructure. On aircraft carriers, they will be high on the island and on subs, close to the conning tower.

It should be kept in mind that Mark 2, Model 2, with modifications or attachments, may be used either for surface search or surface fire control. It is believed that the fire control function requires three horns. The Mark 2, Model 2 set is known as a "micro-wave" Radar, designed for sensitive readings and accurate plotting of surface craft and not for great range.

All information on this page is taken from P.O.W. and captured document sources.



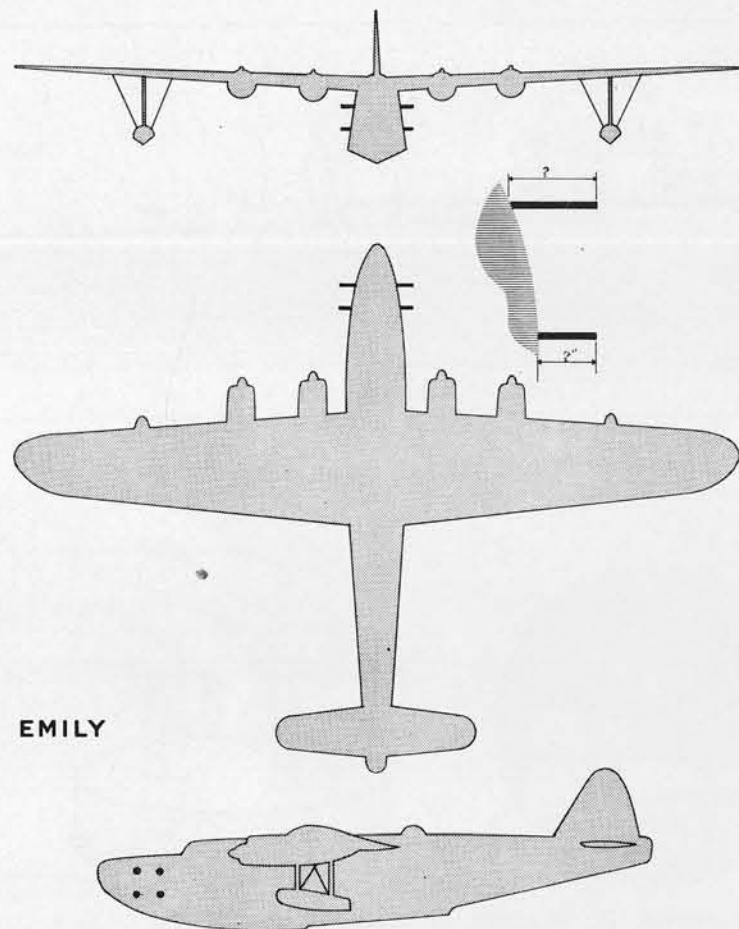
MATSU CLASS DD



LOCATION .....	SHIPBORNE
TYPE ..... (MK. 2, MODEL 2 & MODIFICATIONS)	"HORN TYPES"
ANTENNA .....	ELECTROMAGNETIC HORNS
FREQUENCY .....	3000 MCS
P.R.F. .... 2500	PULSE ..... 6
MAXIMUM RANGE .....	25 N. MI.

# RADAR

## AIR BORNE TYPES



EMILY

EMILY, large Japanese Patrol Bomber, has a linear array in the forward part of the hull.

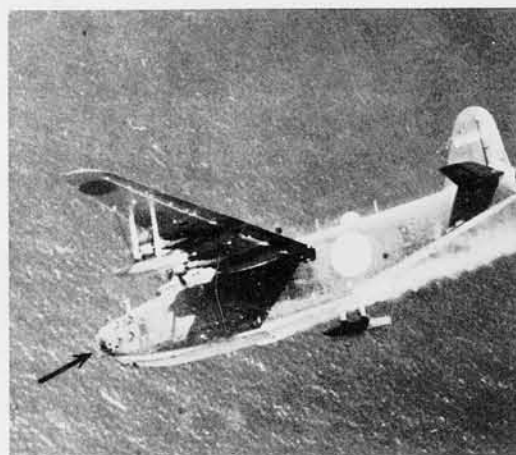
All plane types probably contain the same Radar equipment, designated as "Mark VI, Model 4", and operating at 150 mcs., with range of approximately 75 nautical miles.

Japanese Airborne Radar antennae can often be detected from aerial photographs. The Japanese probably have but one airborne model in wide use at present (MARK VI, MODEL 4), but a variety of types and locations of antennae are used. This is a search Radar.

Antennae may be a Yagi, dipole, or linear array, and may be located in the nose, leading edge of wing, or side of fuselage.

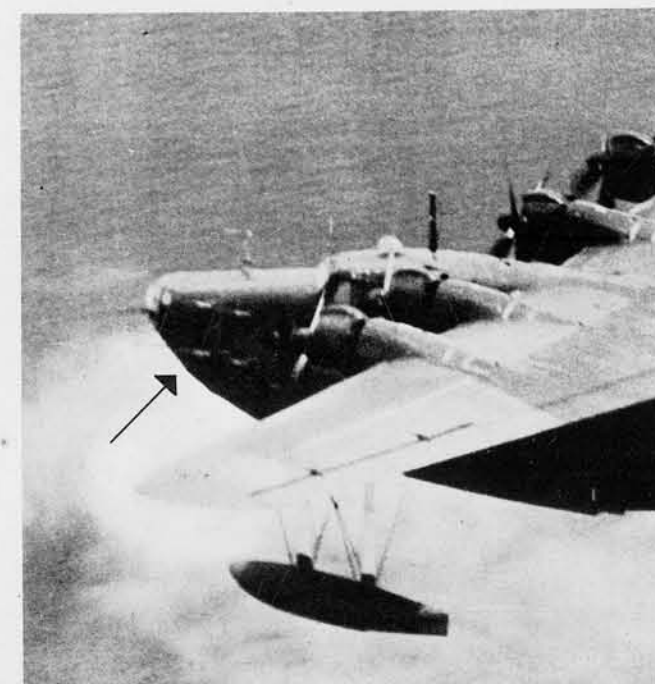
Undoubtedly, several other types will be forthcoming soon, particularly for use in night fighters.

BETTY, Japanese Medium Bomber, was the first to use Airborne Radar. The antennae consists of a nose Yagi and a small "H" shaped arrangement on the side of the fuselage.



EMILY

LOCATION . . . . . EMILY  
TYPE . (AIR MK. 6, MODEL 4) . "AIRBORNE"  
ANTENNA . . . . . LINEAR ARRAY  
FREQUENCY . . . . . 150 MCS  
P.R.F. . 1000 . . . PULSE . . . . . 5  
MAXIMUM RANGE . . . . . 55 N. MI.?

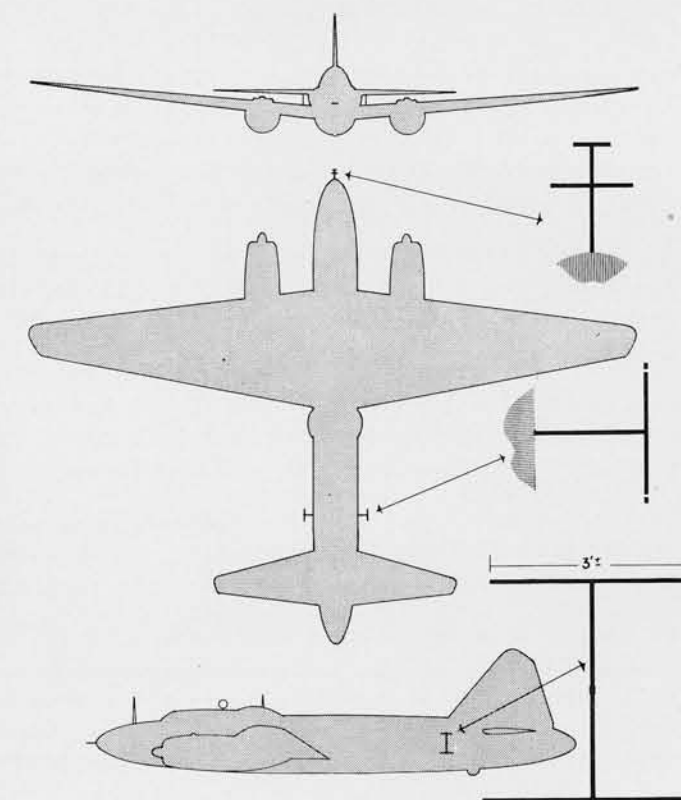


EMILY



BETTY

LOCATION . . . . . BETTY  
TYPE . (AIR MK. 6, MODEL 4) . "AIRBORNE"  
ANTENNA . . . . . NOSE YAGI & "H" ARRAY  
FREQUENCY . . . . . 150 MCS  
P.R.F. . 1000 . . . PULSE . . . . . 5  
MAXIMUM RANGE . . . . . 55 N. MI.?



BETTY

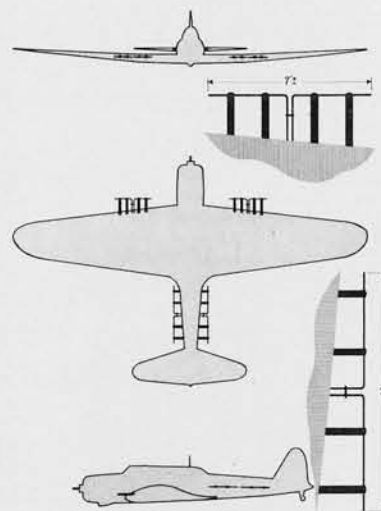
CONFIDENTIAL

# RADAR

## AIR BORNE TYPES (CONT.)

KATE, Japanese Torpedo Bomber, has been fitted with dipole antennae. There are two 5 foot dipoles on the leading edge of the wings, and two 8 foot dipoles on the sides of the fuselage. Antennae on JUDY is reported to be the same design as KATE.

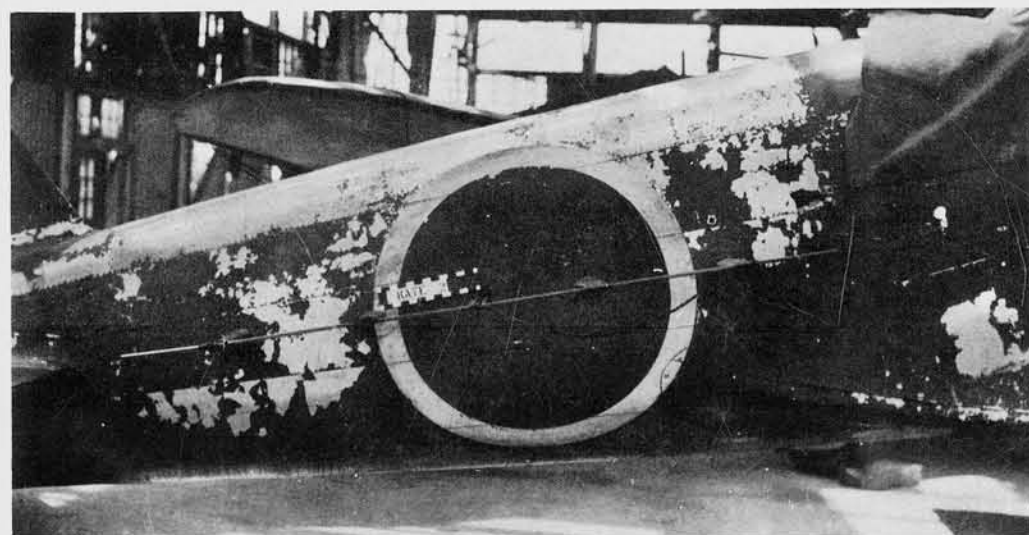
LOCATION . . . . . KATE & JUDY  
TYPE . . . (AIR MK. 6, MODEL 4) . . . "AIRBORNE"  
ANTENNA . . . . . DIPOLES  
FREQUENCY . . . . . 150 MCS  
P.R.F. . . . 1000 . . . . . PULSE . . . . . 5  
MAXIMUM RANGE . . . . . 55 N. MI. ?



KATE



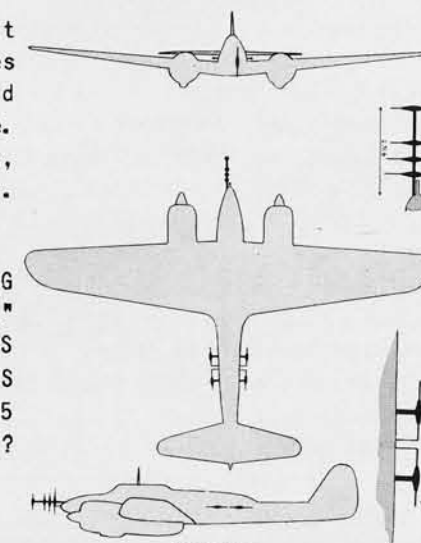
KATE



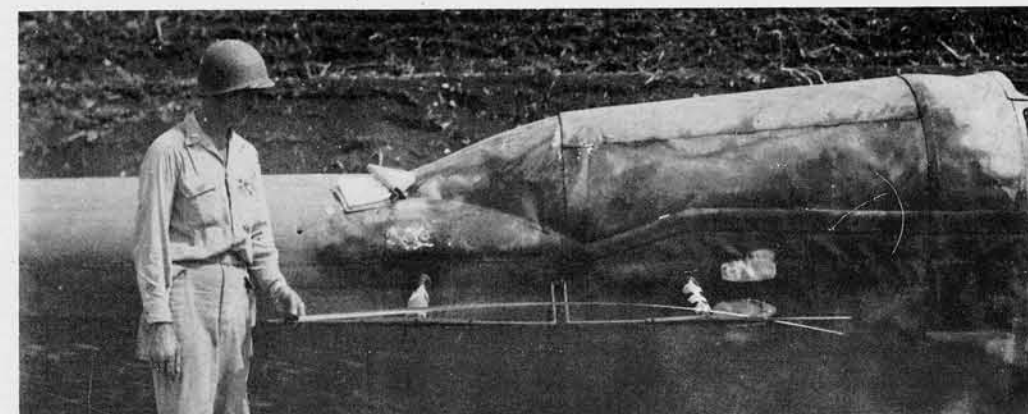
KATE

IRVING, Japanese Reconnaissance and Night Fighter plane is equipped with Yagi dipoles in the nose (similar to German designs) and a 6 foot dipole on either side of the fuselage. All dipoles are set in heavy insulators, which can be seen in fairly small photography.

LOCATION . . . . . IRVING  
TYPE . . (AIR MK. 6, MODEL 4) . . . "AIRBORNE"  
ANTENNA . . . . . NOSE YAGI & DIPOLES  
FREQUENCY . . . . . 150 MCS  
P.R.F. . . . 1000 . . . . . PULSE . . . . . 5  
MAXIMUM RANGE . . . . . 55 N. MI. ?



IRVING



IRVING



IRVING

**CONFIDENTIAL**



# RADAR

## FIRE CONTROL (MK. IV, MOD. 3)

Japanese land-based Fire Control Radar is now coming into general use. Although information is sketchy and incomplete as to the types that may be most used, facts and pictures which are now available are shown and discussed on these pages. At this time there are apparently three basic trends in Japanese Fire and Searchlight Control Radar:

(1) Models based on British "SLC" (Yagi antennae mounted on a searchlight, which was probably captured on Singapore).

(2) Models based on the United States SCR268, probably captured on the Philippines.

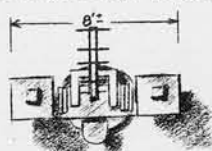
(3) Models based on British GL, Mark 2, which uses separated transmitter and receiver installations with elaborate arrays.

In addition to these general types, the possibility of the Japanese developing a copy of the German Wurzburg for land-based fire control must be kept in mind.

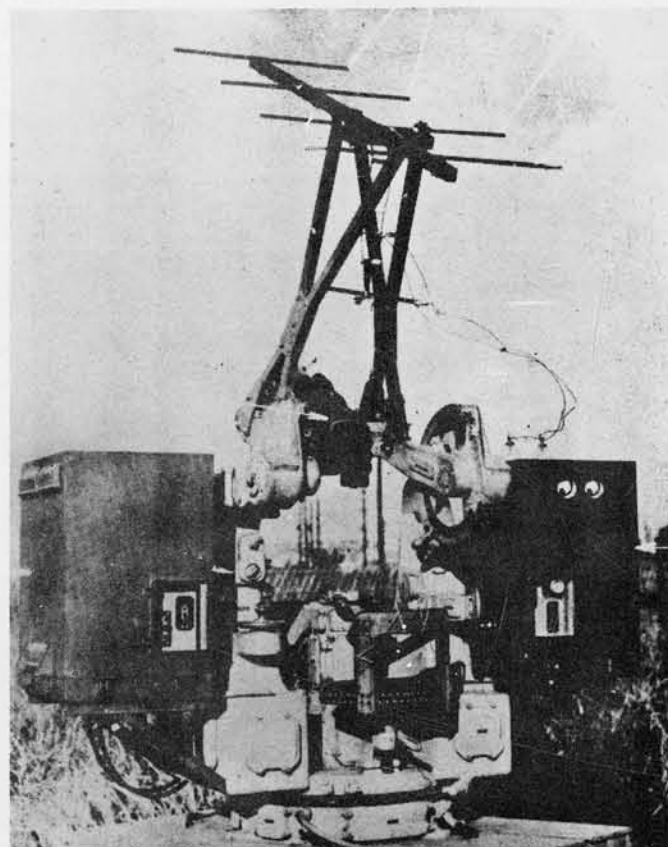
The Japanese designation of the installation shown on this page is "Mark IV, Model 3". It is a 200 mcs Radar consisting of two parts: (1) The Transmitter (mounted on a searchlight controller), which supports one row of Yagi antennae on an elevated cross arm. The whole mount, including antenna and operator's seat, rotates, and the antenna tips up and down. Radar equipment is on either side of the operator.

(2) The Receiving antenna, consisting of 4 Yagis mounted on a type 96 110 cm. searchlight. (See below, right.) It is lobe switched at 25 per second. Note that searchlight shown here is mounted on a hut.

The pictures shown here are of the first fire control equipment captured in the Pacific war, and indicate an adaptation of the British S.L.C. In these examples, it will be noted that the transmitting and receiving antennae were on separate mounts at separate locations.

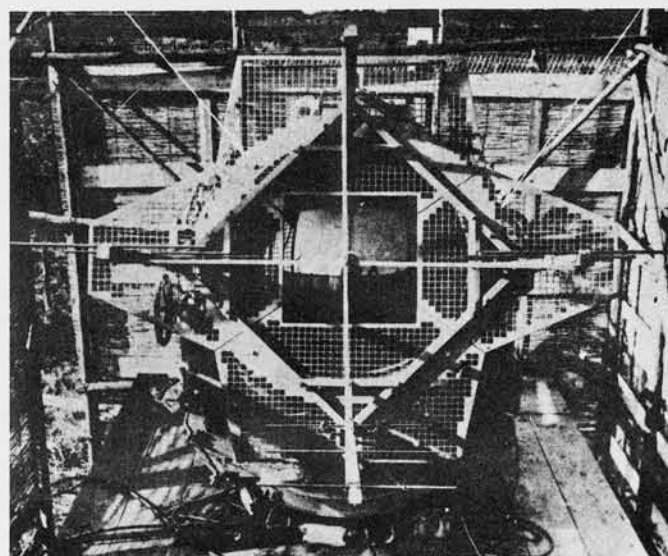


LOCATION . . . . . MARIANAS  
TYPE . . . . . MARK IV, MODEL 3  
ANTENNA . . . . . YAGI'S  
FREQUENCY . . . . . 200 MCS  
P.R.F. . . 2000 . . . PULSE . . . . . 3 - 5  
ACCURACY. RANGE - 100 YDS., BEARING - 1°, ELEV - 1°



TRANSMITTING ANTENNA

The pictures shown on this page are of the first captured equipment in the Pacific war, and indicate an attempt was made to copy the British S.L.C.



RECEIVING ANTENNA



TRANSMITTING ANTENNA

In these examples, it will be noted that the transmitting and receiving antennae were on separate mounts at separate locations.



TRANSMITTER MOUNT

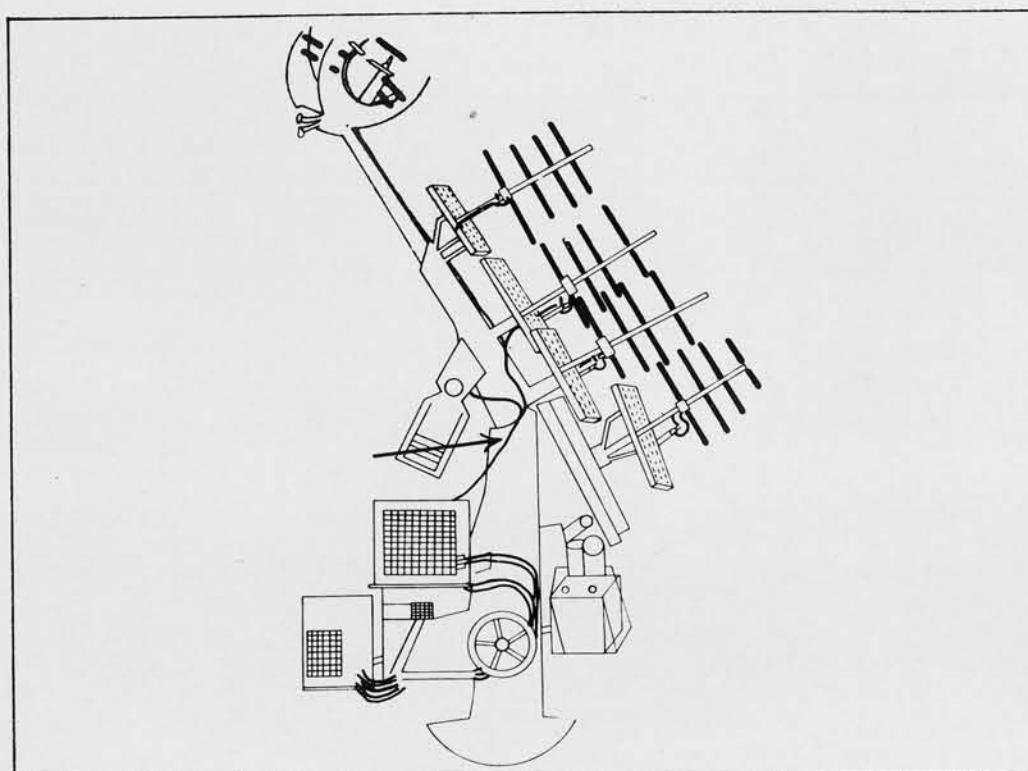
# RADAR

## (MK. TA., MOD. 1) FIRE CONTROL

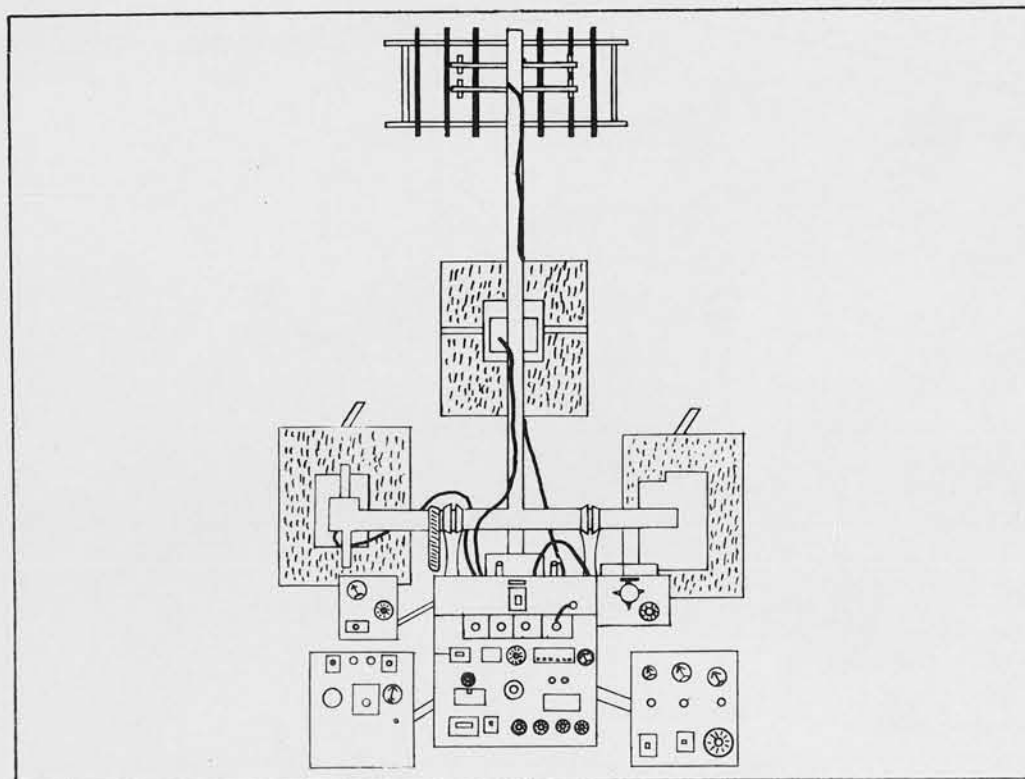
It is thought that the Mark "TA", Model 1 A/A Fire Control Radar operates in a similar manner, basically, to the Mark IV, Model 3 which is shown on the previous page.

However, in this case, the transmitting antenna is mounted above the four receiving Yagis, on the same piece of equipment. Also, the mount is believed to be of special design and not a searchlight or searchlight controller. The frequency of this set is 200 mcs. as are most of the Japanese Fire Control Radars at this stage of development.

Most of the information on this page was taken from notes and sketches of a Japanese non-commissioned officer, which were made during training. The sketches leave much to be desired in clarity of drawing. Nevertheless, a rough estimate of size yields the following dimensions: front view 8 - 10 feet wide; side view 12 - 15 feet high. The whole installation rotates, and the vertical shaft appears to tip back at point A.



SIDE VIEW



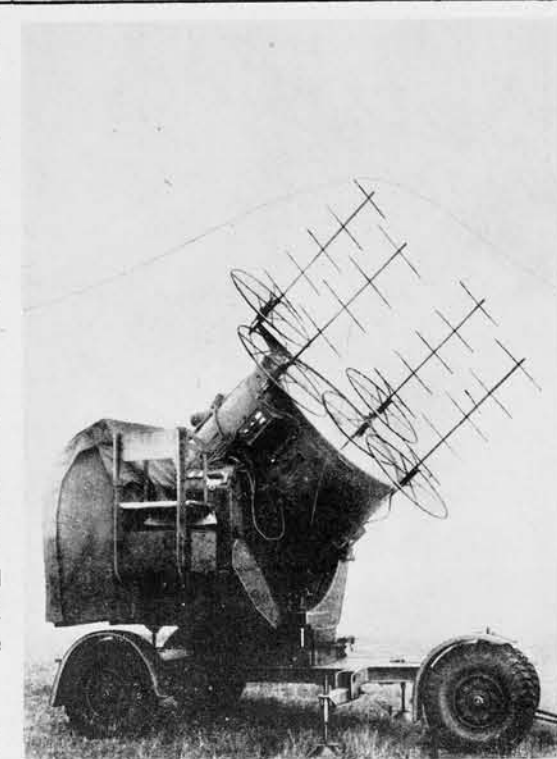
FRONT VIEW

LOCATION . . . . .	A/A OR S/L
TYPE . . . . .	MARK "TA", MODEL 1
ANTENNA . . . . .	YAGI S
FREQUENCY . . . . .	200 MCS
P.R.F. . . . .	PULSE . . . . . 3

Captured documents have referred to a Mark "TA", Model 2, Fire and Searchlight Control Radar, but very little is known about this set except for the following data: Frequency - 200 Mc., PRF - 1000 Cps., Pulse - 2 microseconds, Range accuracy - 100 yards. It is listed as being designed for A/A Fire Control and Air Warning.

The antennae (5 YAGI S) are thought to be mounted on a searchlight in a manner similar to the British S.L.C., in which case both the transmitting and receiving antennae are mounted together. This is in contrast to the separated design of the Mark IV, Model 3.

A photo of the British S.L.C. (A/A, No. 2, Mark VI) is shown here for reference.



BRITISH S.L.C. (A/A, NO. 2, MK 6)

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# RADAR

## FIRE CONTROL (MK. TA., MOD. 3)

The Mark "TA", Model 3 Fire Control Radar is believed to be radically different from Model 1 and 2 of the "TA" series.

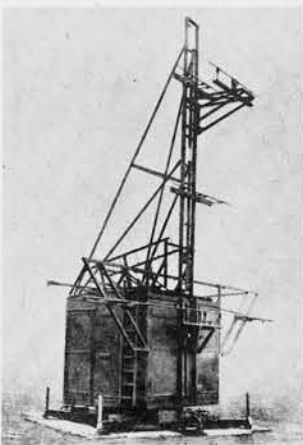
The prototype of this set is probably the British GL Mark 2 which was captured in Malaya.

Most of the present information on this Radar is taken from a captured notebook which was translated and analyzed by Gen. Hq., S. W. P. A.

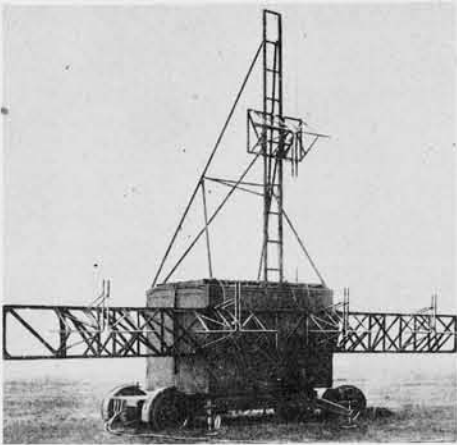
This model is a Low Frequency (75 mcs.) Fire Control Radar which uses a transmitter with a five element Sterba array set close to the ground with a single dipole 20 feet above and a separated receiver which has 6 dispersed dipoles. There may be 80 to 150 feet separation between transmitting and receiving equipment.

A feature of this set which should be of distinct interest to interpreters is the fact that it requires an extensive cleared area around the transmitter, and it is thought by some that a slight (swale-like) depression provides the best siting for its functions as a Fire Control Radar. At any rate, the ground must be clear of trees for a radius of 200 feet or more and should be accurately graded close to the receiver.

Sketches of the probable appearance of the Japanese Transmitter and Receiver as indicated from captured document sources, are shown here, as well as ground photos of the original British equipment from which they are believed to have been copied or adapted.

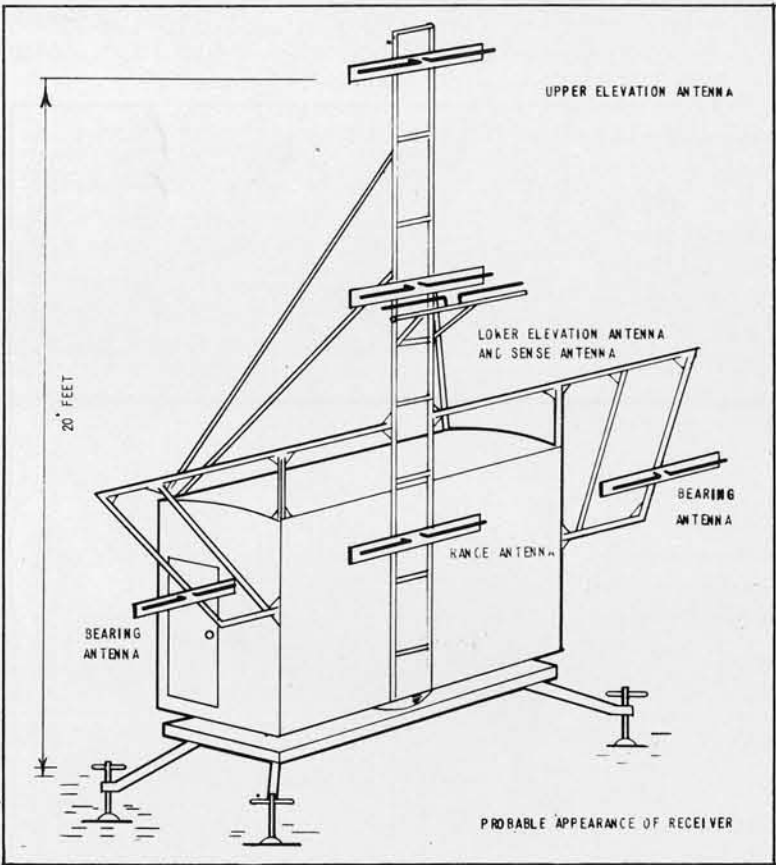


LEFT: BRITISH G.L.  
(A/A, NO. 1, MK. 2)  
RECEIVER.

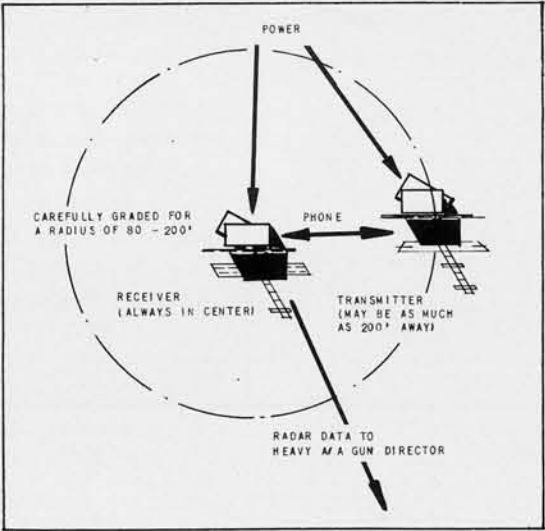


RIGHT: BRITISH G.L.  
(A/A, NO. 1, MK. 2)  
TRANSMITTER.

LOCATION.....	A/A OR S/L
TYPE.....	MARK "TA", MODEL 3
ANTENNA.....	STERBA ARRAY & DIPOLES
FREQUENCY.....	75 MCS
P.R.F.....	1000-2000
PULSE.....	1 - 2
ACCURACY.....	RANGE - 25 YDS., BEARING - 0.5°, ELEVATION - 1°

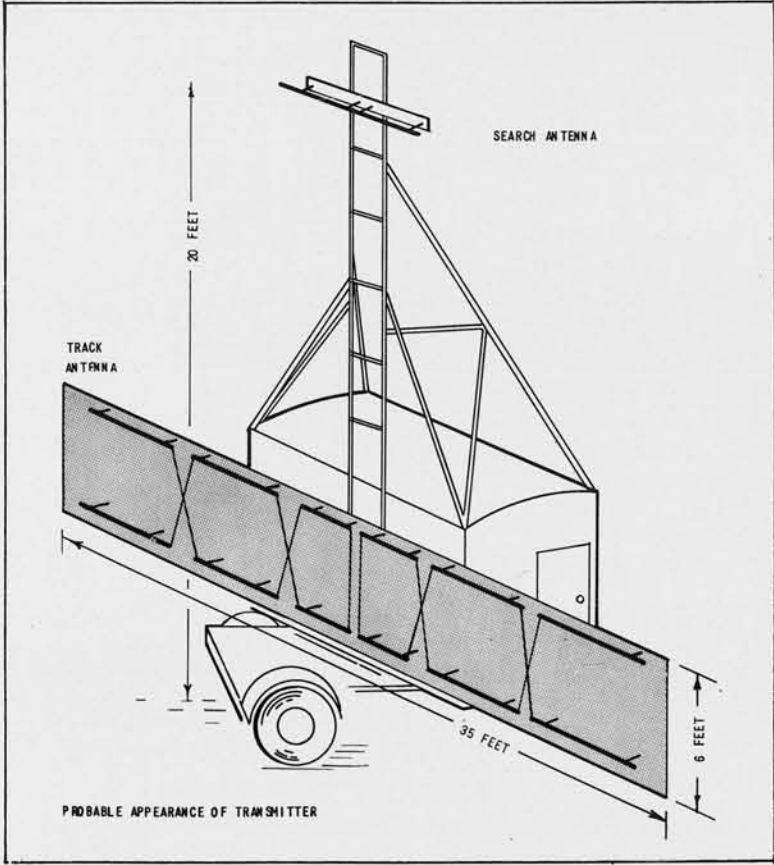


RECEIVER



HYPOTHETICAL PLAN

The above sketch represents an hypothetical arrangement of the Mark "TA", Model 3, as seen in plan view. However, the circular clearing and graded area may vary considerable in size. Ground mats may be used instead of clearing and grading.



TRANSMITTER



ATTU type Japanese radar, captured at TARAWA in the GILBERTS. This ATTU type radar was in an unassembled state when first found at ATTU, ALEUTIANS. Electrically very similar to the GUADALCANAL type radar, but representing an improved modification. Note the horizontally elongated box-like shape of the screen which forms the most important identification factor. Spotting of radar positions in aerial photos is largely dependent on screens and screen shadows.

At BITITU Island, TARAWA Atoll were two ATTU type radars of identical design. One was at the west end and the other a few hundred feet from the east tip. Both were set on high concrete bases and were used for different sectors of the air and surface search.

LOCATION.....	TARAWA
TYPE.....(MARK I, MODEL I, MODIF. I).....	ATTU
ANTENNA.....	28' x 14' x 2' 4"
FREQUENCY.....	100 MCS
P.R.F.....880 - 1200.....	PULSE. ....12 - 30
MAXIMUM RANGE.....	75 N. MI.

MOBILE MATTRESS, or MARK I, MODEL II. This radar operated at 200 mcs. and is identified by a small screen (14' x 7') mounted on a Japanese standard army trailer (type 94). This radar was used for land-based search, either alone or in conjunction with older types. The shack, antenna, revolving mount and trailer could be separated for shipping purposes.

MARK 6 PORTABLE. This is an adaptation of the same set used in aircraft for search (Mark 6, Model 4). This set was found on GUAM. Antenna consists of dipoles. Frequency...150 mcs. Maximum range about 30 N. MI.

LIMBER PREYA WITH I.P.F. This is one of the earliest types of German equipment, developed for air search or early warning. Practical range was 75 Naut. miles. The high blast wall was a characteristic of Preya installations.

SMALL WURZBURG or BOWLFIRE was first designed in 1936 and was one of the most efficient German radars. It was used primarily for A. A. fire control but was a standby for Ground Control of Acft, Acft reporting and Searchlight Control. In general was a mobile radar, mounted on a four-wheeled trailer with outriggers for levelling.

GIANT WURZBURG - 3/4 VIEW.....This was a fixed, non-mobile radar for measuring range, bearing and height of target Acft. Principal use was for Ground Control Intercept. Practical range---40 N. MI.

# RADAR

(MK. IV, MOD. I) FIRE CONTROL

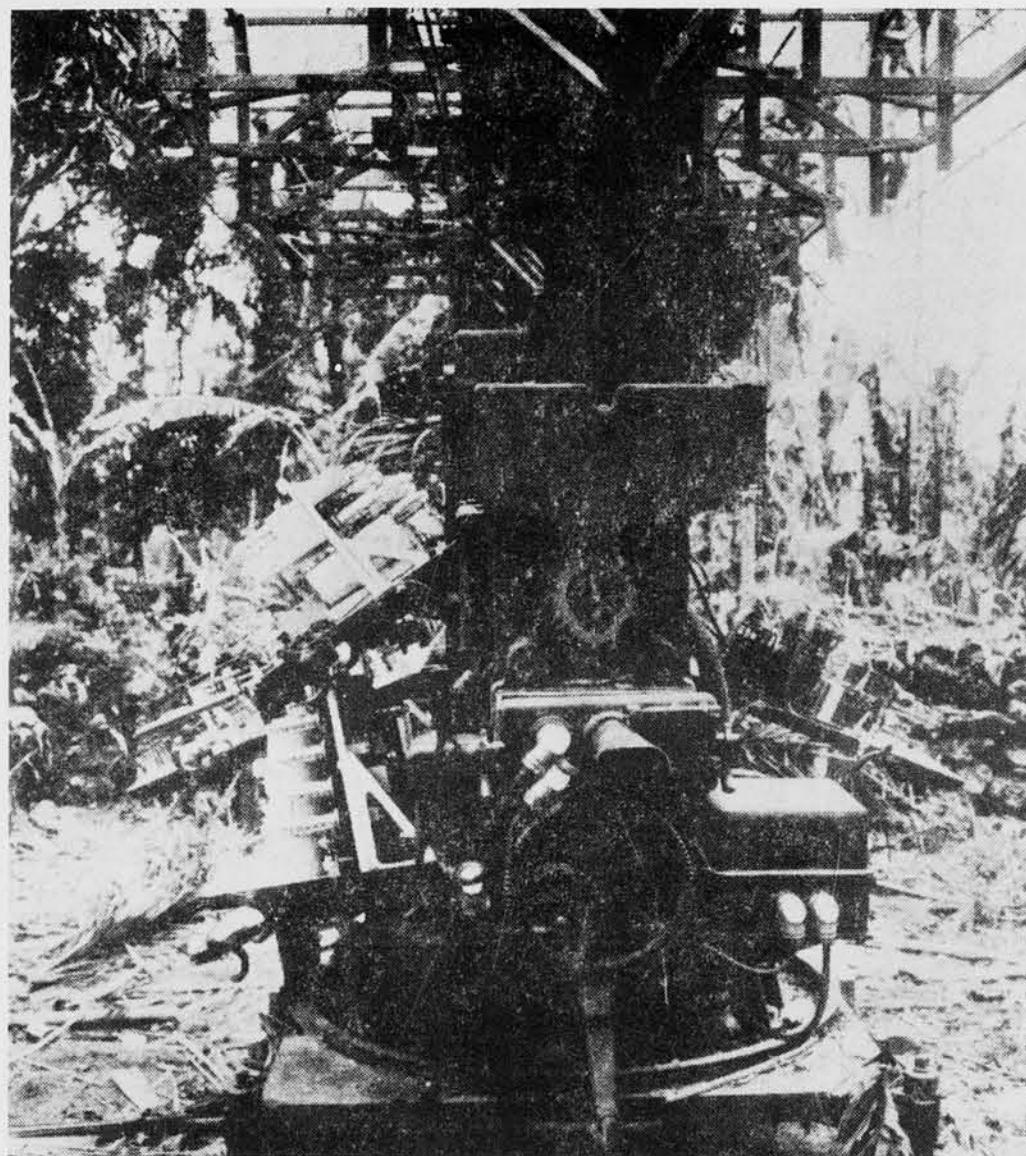
The Japanese adaptation of our SCR 268 Fire Control Radar was first captured on Peleliu and is believed to be the same set referred to in captured documents as "Mark IV, Model I," and sometimes as "S-3".

The Mark IV, Model I (shown on this page) is a Fire Control Radar which operates at a frequency of 200 mcs. This set is not well adapted to mass production for wide use. Captured documents refer to a "Mark IV, Model 2" and a "Mark IV, Model 2, Modification 2" which may indicate that future use of a smaller improved model or models of this Radar, designed for mass production, can be expected.

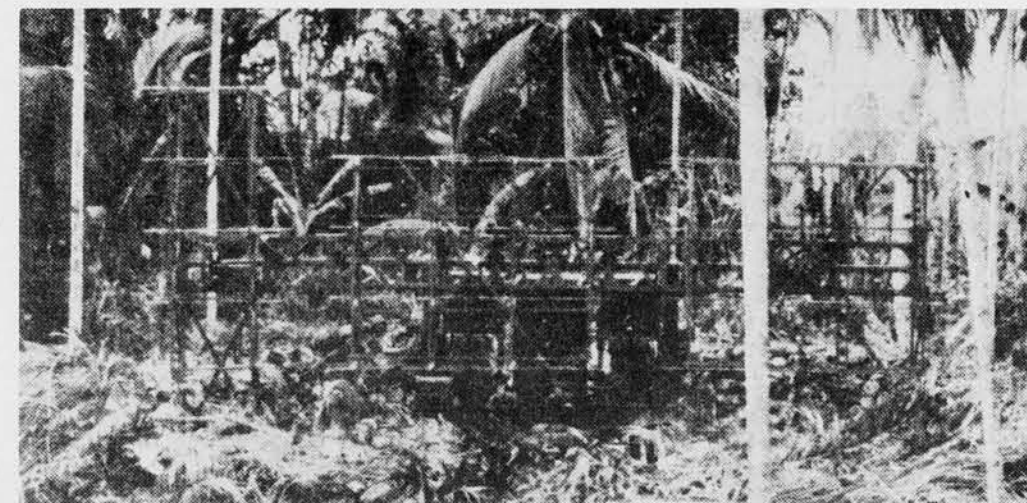
The "Mark IV, Model I" type(or types)will function better when sited in a cleared graded area.

There are three antenna bays mounted on a 25 3/4-foot long horizontal beam which in turn is mounted on top of the large frame which supports all the various units of the radar. The beam is about 9 feet above ground base. All antenna elements reflectors, radiators, and directors are lengths of 1/4 inch copper tubing mounted by means of ceramic insulators on wooden frames which are fastened to the cross beam.

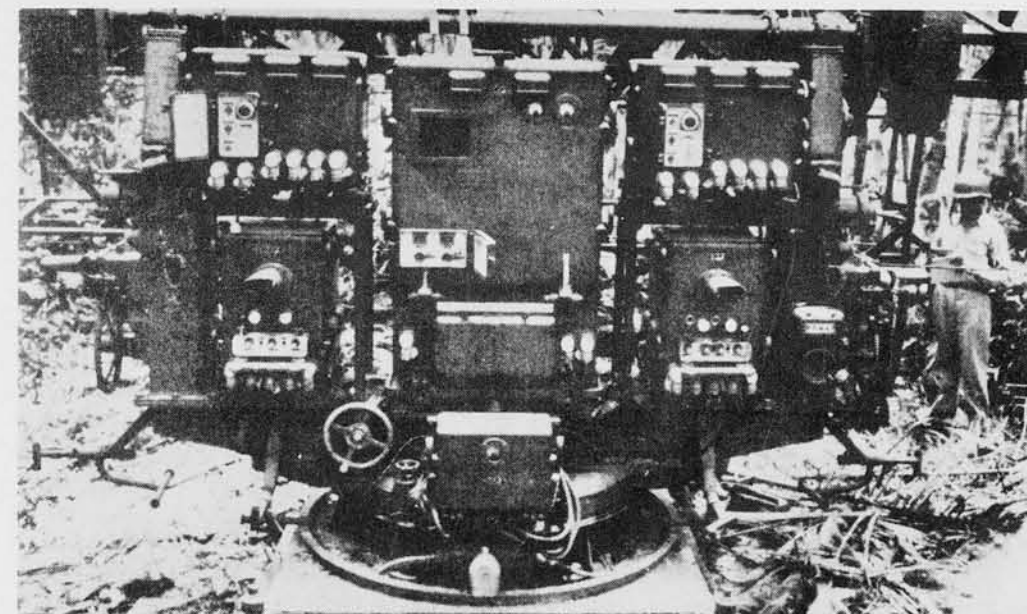
LOCATION.....	PELELIU
TYPE.....	MARK IV, MODEL I
ANTENNA.....	25 3/4' x 6' x 4' MATTRESS
FREQUENCY.....	200 MCS
P.R.F.....	2000 PULSE..... 3 - 5
ACCURACY ...	RANGE - 50 YDS. BEARING - 0.5° ELEVATION - 0.5°



SIDE VIEW



FRONT VIEW



DETAIL OF BASE

CONFIDENTIAL



# RADAR

## SUPPLEMENTARY MATERIAL (FIRE CONTROL)

### FIRE AND SEARCHLIGHT CONTROL RADAR

Here, under the heading, "Supplementary Material", is shown a collection of stereograms of interest to the photographic interpreter when checking on new patterns in aerial photographs which suggest Fire Control Radar.

Conservatively, all of the installations should be referred to as being "suspicious" if not "probable". However, it must be borne in mind that none have been positively identified.

To review the Fire Control Radar situation at the close of 1944, the following trends and types are believed to be in use or in production:

British "SL" Types	British "GL" Types	United States SCR 268 Types
1. Mark IV, Model 3	1. Mark "TA", Model 3	1. Mark IV, Model 1 (S-3)
2. Mark "TA", Model 1		2. Mark IV, Model 2
3. Mark "TA", Model 2		3. Mark IV, Model 2, Mod. 2

In addition to those listed above, the German Wurzburg should be watched for, as well as other Japanese types which have been reported, but on which little information is available at this time.

Fire Control Radar interpretation is also a part of gun interpretation, and an understanding of the equipment and functions of anti-aircraft fire control centers and guns is helpful to identification. (See P.I.C. Publication #3: "Japanese Anti-aircraft and Coastal Defense Guns")

Certain specific forms and patterns have been observed repeatedly in pictures taken over Japanese-controlled territory, which have created

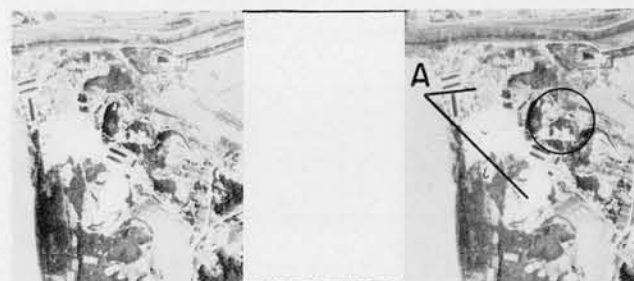
suspensions as to the presence of Fire Control Radar. In each case the forms in question are found close to heavy A/A and are sited fairly well for the functions of Fire Control Radar. It is believed, further, that such forms and patterns do not represent other known functions of A/A fire control such as directors, visual range finders, sound locators, searchlights, etc.

In general, these forms and patterns may be classified as follows:

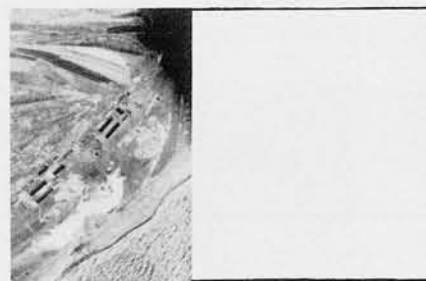
1. A circular cleared area, often with a saucer-shaped depression, with a diameter of from 150' to 200'.
2. A 22' diameter cylindrical form, about 10' high (possibly with a conical roof) out of the center of which extends a vertical shaft supporting a cross-arm (antennae?). The whole is frequently enclosed in a low revetment of 50' diameter.
3. A small circular revetment, enclosing "something", from which a buried cable is observed running to the fire control center (to the director?) and thence to the heavy A/A guns.

It must be borne in mind that A/A Fire Control Radar need not be sited on the highest point of land, but often will be found in low flat areas, wide valleys, and frequently on the same level or lower than the heavy A/A guns.

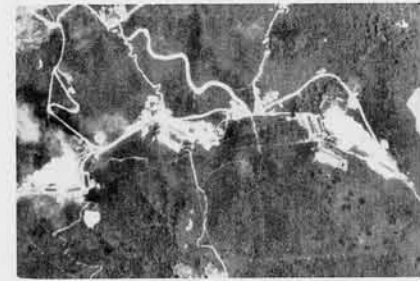
When searchlight revetments are found accompanied by another circular revetment, and not in the immediate vicinity of heavy A/A batteries, the extra revetment is likely to contain either Searchlight Control Radar or a Sound Locator.



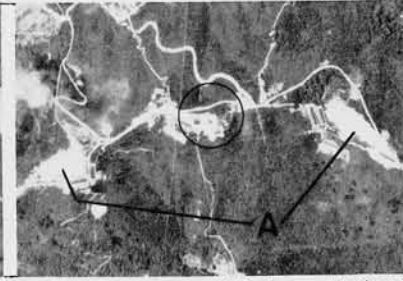
UNIDENTIFIED (R.F. - 1/16170)



UNIDENTIFIED (R.F. - 1/16170)



UNIDENTIFIED (R.F. - 1/16170)



#### ABOVE:

The cylindrical form is similar in shape and dimensions to the standard concrete water cistern, i.e., 20-22 feet in diameter and approximately 10 to 12 feet in height. The revetment is about 50 feet inside diameter. A definite shadow, presumably from a horizontal cross arm erected on top of this structure, looks very much like antennae and causes speculation on the possibilities of the installation enclosing Fire Control Radar. Each of these installations is in association with two 6-gun heavy A/A batteries marked "A".

RIGHT: One of the numerous types of circular clearings seen recently. This particular one on Honshu contains Mark "TA", Model 3 Fire Control Radar.



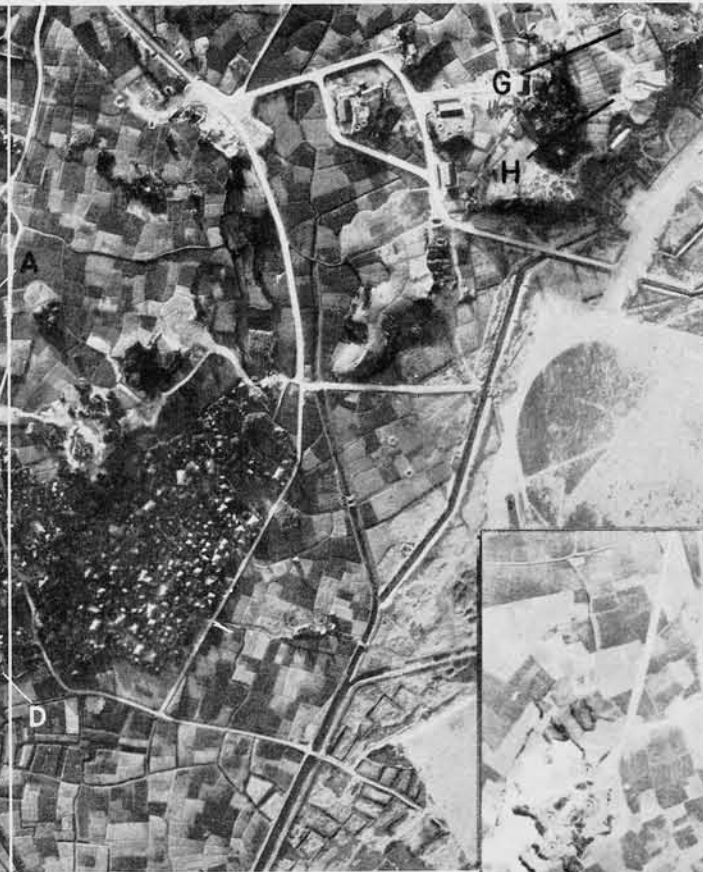
PROBABLE MK. "TA", MOD.3

(R.F. - 1/17000)



# RADAR

## SUPPLEMENTARY MATERIAL (FIRE CONTROL)



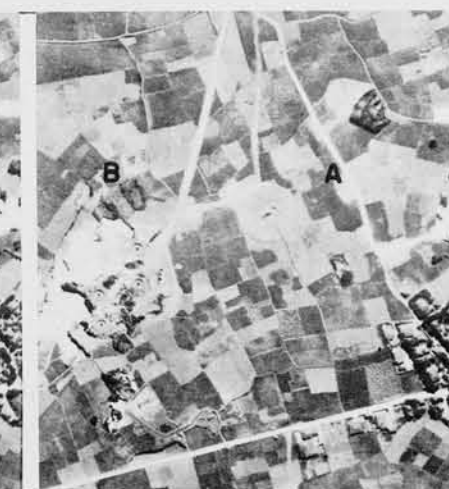
The installation at "A" although not conclusively identified, is believed to be the "Mark IV, Model 1, S-3" Fire Control Radar, an adaption of United States type SCR 268. It is mounted in the center of a 150' diameter circle having a concave cross section resembling a saucer shape.

Note the presence of a drainage ditch leading out from the center of the circle. An underground entrance and a low guyed stick mast are also present. Radar is 550 feet from the nearest heavy AA gun emplacement ("B").

PROBABLE MK. IV, MOD.1

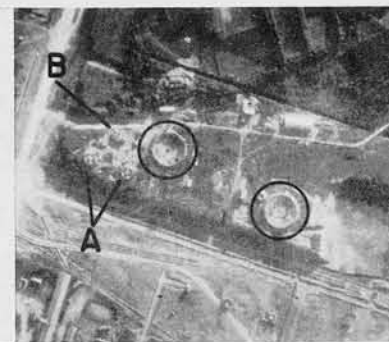
(R.F. - 1/7500)

"A" - Probably Fire Control Radar. "B" - 4-Gun 120 mm. AA Battery (Also construction activity). "C" - 25 mm. AA Guns. "D" - Device For Processing Sugar Cane or Rice. "E" - Searchlight (150 cm.?). "F" - Sound Locator. "G" - Probable Searchlight (110 cm.?). "H" - Unidentified Construction, possibly S/L Control Radar.



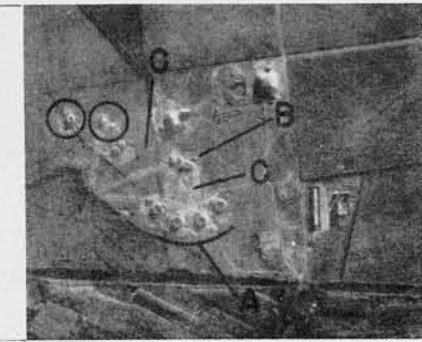
(R.F. - 1/5500)

PROBABLE MK. IV, MOD.1



UNIDENTIFIED

"A" - HEAVY A/A GUNS (127 MM?) "B" - FIRE CONTROL CENTER  
Encircled forms are saucer-shaped and are 150 feet in diameter. The sides of the saucer are built up above grade. The lowest part of the saucer is probably on grade or slightly below. A shadow from a vertical shaft is seen in the left emplacement.



SUSPECTED MARK IV, MODEL 3

"A" - HEAVY A/A BATTERY "B" - FIRE CONTROL CENTER "C" - BURIED CABLE  
The encircled emplacements above are believed to contain Fire Control Radar equipment, possibly Mk. IV, Mod. 3. (If only one emplacement is in use, Mk. "TA", Mod. 1 or 2 would be likely.) Note underground cable leading to Fire Control Center, a distance of 550', and thence to each heavy A/A gun position.

# RADAR

## SUPPLEMENTARY MATERIAL (FIRE CONTROL)

The Mark "TA", Model 3 Fire Control Radar, which is an adaptation of the British GL, Mark 2, has been the most frequently identified model up to the present, particularly on Honshu. This is partially due to the ease of recognition of this particular type. Three examples which are believed to contain Mark "TA", Model 3 are included on this page.

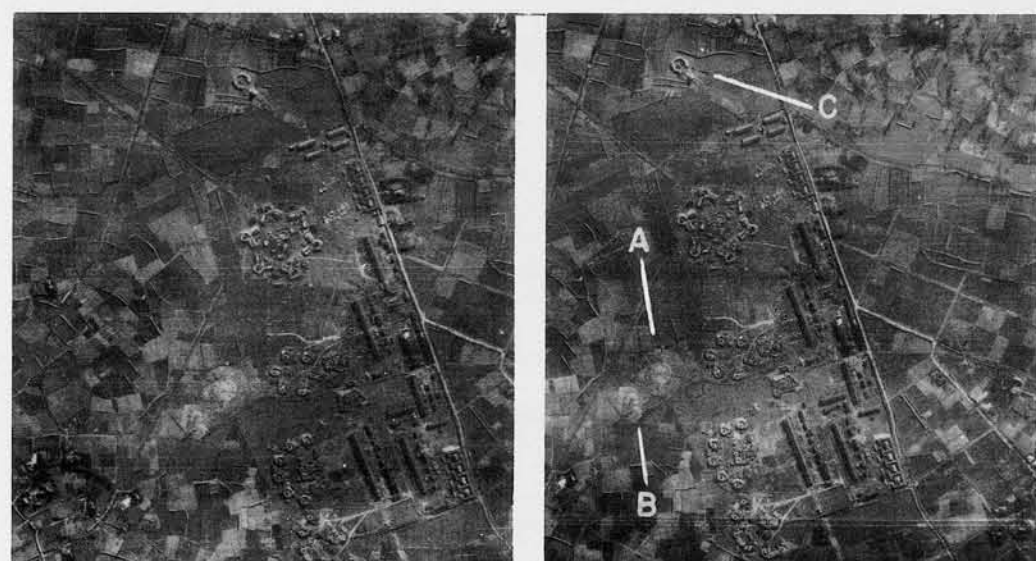
Two Searchlight Stations with accompanying Sound Locator revetments are included here for comparative purposes.



PROBABLE MARK "TA", MODEL 3

(R.F. - 1/9000±)

"A" - RECEIVER; "B" - TRANSMITTER; "C" - SUSPECTED D. F.



PROBABLE MARK "TA", MODEL 3

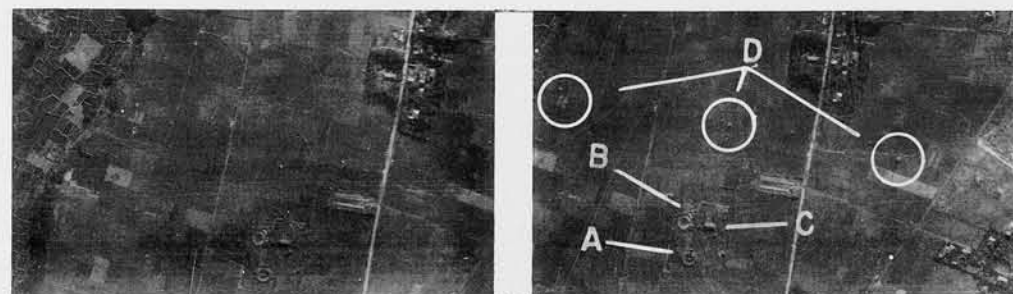
(R.F. - 1/9000±)

"A" - RECEIVER; "B" - TRANSMITTER; "C" - SEARCHLIGHT

The two stereograms shown above are good examples of Mark "TA", Model 3. Fire Control Radar set up with heavy A/A gun batteries.

The circular clearings around the transmitter are about 200' in diameter and are carefully graded. (The inner circular clearing in lower stereogram is 100' in diameter.) Cable lines run between the transmitter and the Receiver and from the Receiver to the Director (in the Fire Control Center). Receiver is usually 500' - 600' from the Fire Control Center.

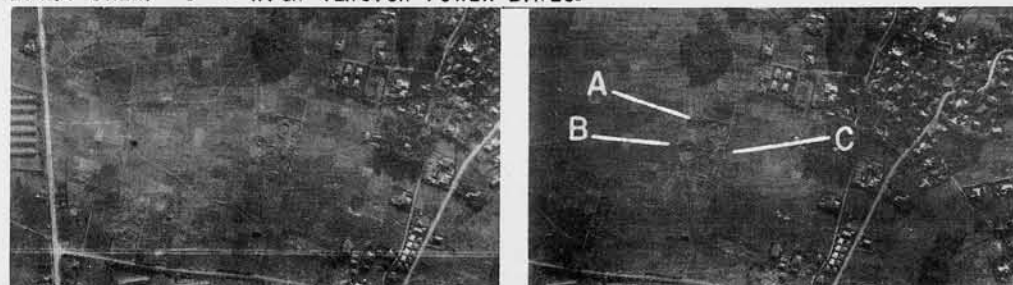
All guns shown are 75 millimeter except the hexagonal battery in lower stereogram which is probably composed of 120 millimeter guns.



SEARCHLIGHT

(R.F. - 1/9000±)

"A" - SEARCHLIGHT; "B" - SOUND LOCATOR; "C" - BARRACKS BUILDING FOR SEARCHLIGHT CREW; "D" - HIGH TENSION POWER LINES.

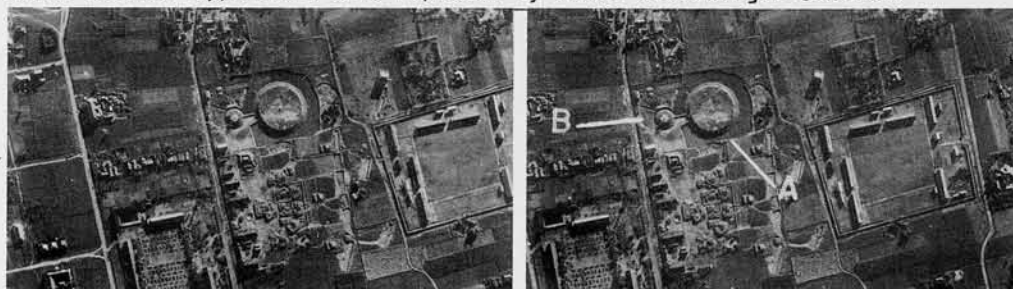


SEARCHLIGHT

(R.F. - 1/9000±)

"A" - SEARCHLIGHT; "B" - SOUND LOCATOR; "C" - BARRACKS BUILDING FOR SEARCHLIGHT CREW.

The two stereograms shown above are of Searchlight Stations with Sound Locator control. These are included for comparison with Radar Fire Control emplacements. Although these are fairly typical examples of Sound Locator revetments, it would be difficult to ascertain, at this scale, if the Sound Locator apparatus were replaced by Radar Searchlight Control.



SUSPECTED MARK "TA", MODEL 3

(R.F. - 1/9000±)

"A" - RECEIVER; "B" - TRANSMITTER.

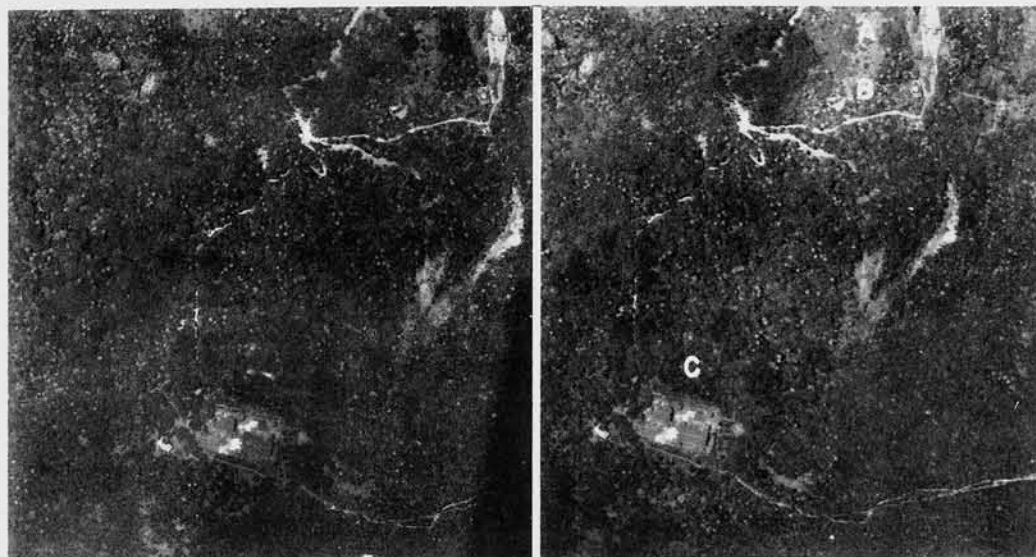
In this stereo, the form that resembles a buried fuel tank is apparently surmounted by a Mark "TA", Model 3 Receiver. The A/A battery appears to be composed of 75 mm. guns. This is a smaller group of guns than is usually found with Radar Fire Control of this type.

Several other examples of Mark "TA", Model 3 have been found recently (in addition to those shown in this book). At the present time, it has been identified more frequently than any other type - but this may be partially due to the fact that it offers the most obvious identifying characteristics.



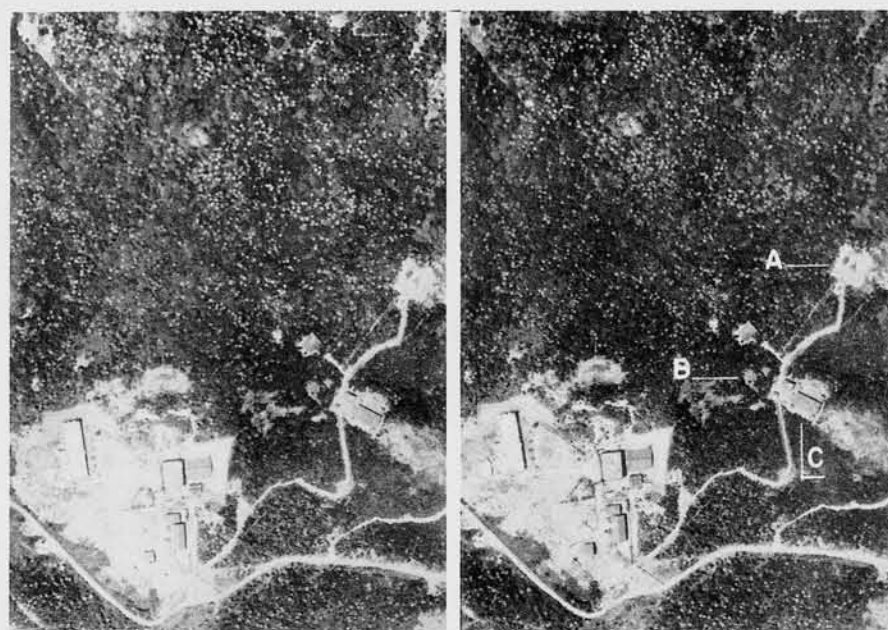
# RADAR

## SUPPLEMENTARY MATERIAL (SEARCH)



CHICHI JIMA, BONIN IS.

(R.F. - 1/5500±)



CHICHI JIMA, BONIN IS.

(R.F. - 1/6000±)

Two radar sites on Chichi Jima show a standardization of associated structures which may prove helpful for interpretation at scales too small to clearly identify the Radar itself.

"A" - MARK I, MODEL I RADAR.

"B" - OBSERVATION PLATFORM ON TOP OF BUILDING.

"C" - PROBABLE BARRACKS BUILDING.

Radio Station at "D" is 700 feet from Radar, and is not related.

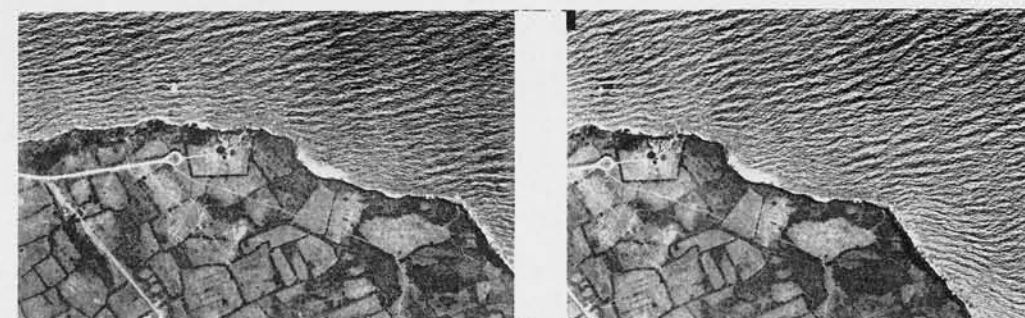
**CONFIDENTIAL**



DARIEN, MANCHURIA

(R.F. - 1/13000)

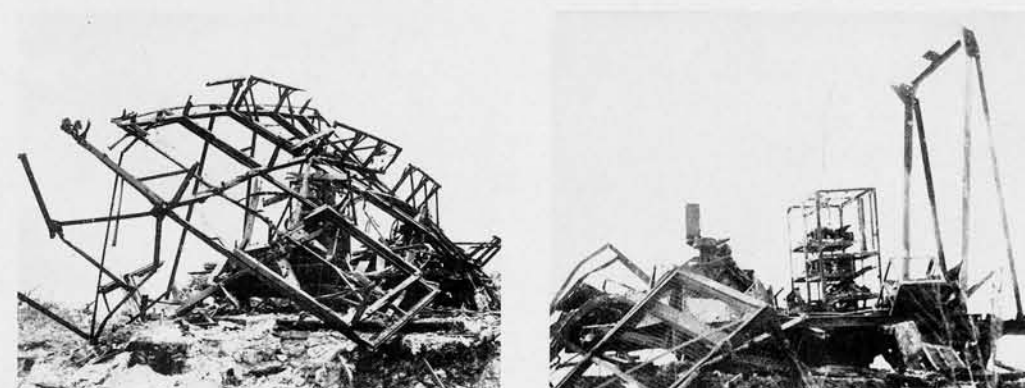
Unidentified installation at Darien, Manchuria, which is thought to be a long range Early Warning Coastal Radar similar to the German "Large Hoarding". The screen is 90 feet long by 30-35 feet high, set atop a hill in such a manner as to command the harbor and its approaches. Signals have been reported from this general area which tend to support this interpretation. Larger scale pictures are necessary for final identification.



EARLY WARNING STATION

(R.F. - 1/13500±)

A Japanese Coastal Early Warning Station, above, in the Philippines, is sited in a similar manner to many German examples. Station includes, two Radars - an "Attu" type and a "Chi" type.



GUADALCANAL TYPE - SAIPAN

ATTU TYPE - TINIAN

Views of badly damaged Radars captured on Tinian and Saipan illustrate the fact that both the Guadalcanal Type and the Attu Type Radars are still in use in the same general area.

Both of these radars were clearly visible in pre-invasion vertical coverage.



## SUPPLEMENTARY MATERIAL

## SUPPLEMENTARY MATERIAL

## SUPPLEMENTARY MATERIAL



# RADAR (GERMAN)

## SUMMARY

Examples of German Radar are included here to cover the possibility that the Japanese may have access to German equipment and technicians.

The Germans employ several types of land based installations covering the functions of Air Search, Fire Control, and Coast Watching.

These types are quite well standardized and are much more efficient apparatus than those the Japanese are known to have.

There is now some photographic evidence of German Radar equipment in use by the Japanese. Also, it is known that many other types of German electronics equipment are being used.

The following table represents the latest list of German Radar types with salient information concerning each.

GERMAN LAND BASED RADAR TYPES

NAME	SIZE OF SCREEN*	TOP OF SCREEN ABOVE GROUND	FREQUENCY	RANGE IN NAUTICAL MILES	USE	PAGE NO.
LIMBER FREYA	20'x16' IFF-16 $\frac{1}{4}$ 'x3 $\frac{1}{2}$ '	26 $\frac{3}{4}$ ' - 30' WITH IFF	116-146 MCS.	75	A.S.	1.31
POLE FREYA	20'x16' IFF-16 $\frac{1}{4}$ 'x3 $\frac{1}{2}$ ' OR 20'x8'	32', 35' OR 40' WITH IFF	116-146 MCS.	100	A.S.	1.31
GIRDER CHIMNEY	19 $\frac{1}{2}$ 'x97 $\frac{1}{2}$ '	115'	120-130 MCS.	110	A.S.	1.33
CYLINDRICAL CHIMNEY	60'x97 $\frac{1}{2}$ ' IFF .22' HIGH	110 $\frac{1}{2}$ '	120-130 MCS.	160	A.S.	1.33
GEMA COASTWATCHER	20'x8'	25'	370-390 MCS.	DEPENDS ON ELEVATION (ASL) OF SITE	C.W.	1.34
LARGE COASTWATCHER	35'x 34'	40'	70-90 MCS.	60-75	C.W.	1.35
SMALL HOARDING	63 $\frac{3}{4}$ x 44 $\frac{3}{4}$	50'			C.W.	1.36
LARGE HOARDING	98'x36 $\frac{1}{2}$ '	50'	120-130 MCS.	100-115	C.W.	1.36
SMALL WURZBURG	10' DIAMETER	12 $\frac{1}{2}$ ' IN VERTICAL POSITION	550-580 MCS.	25	F.C.	1.37
GIANT WURZBURG	24' DIAMETER	27' IN VERTICAL POSITION	470-580 MCS.	40	G.C.I., A.S. & C.W.	1.38

\* - WIDTH (HORIZONTAL DIMENSION) GIVEN FIRST

A.S. - AIR SEARCH

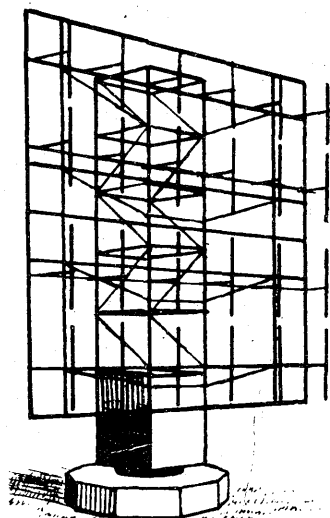
F.C. - A/A FIRE CONTROL

C.W. - COAST WATCHING

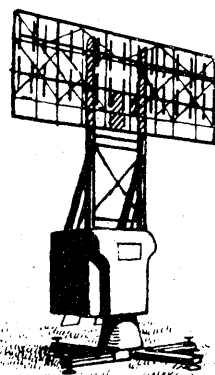
G.C.I. - GROUND CONTROL INTERCEPT

# RADAR

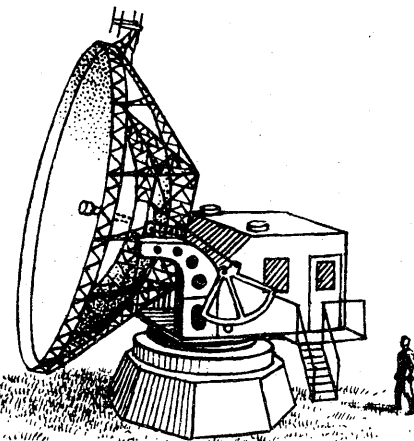
## SUMMARY (CONT.)



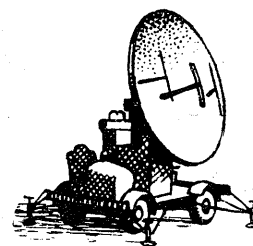
LARGE COASTWATCHER



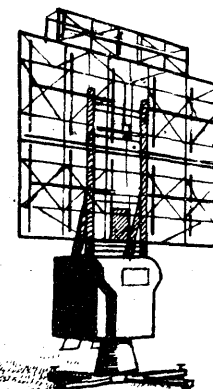
GEMA  
COASTWATCHER



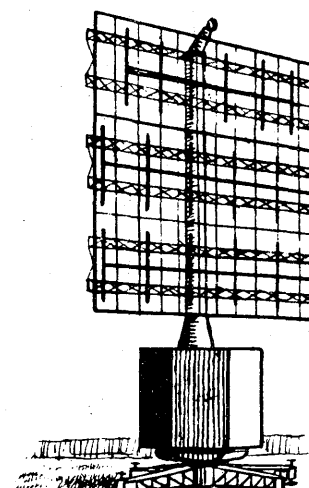
GIANT WURZBURG



SMALL WURZBURG



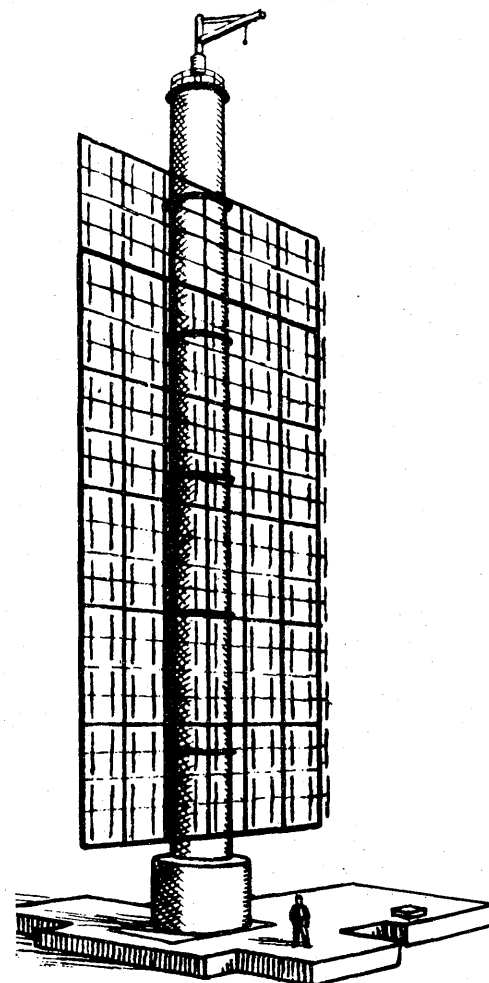
LIMBER FREYA



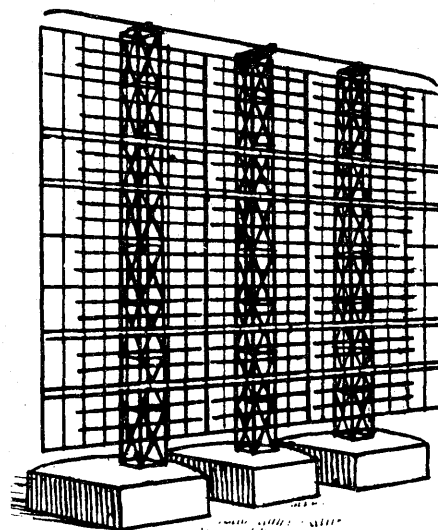
POLE FREYA

Drawings of all of the basic German Radar types are included on this page. Best known popular names are used for the designation of each type. It will be noted that these designs are quite well standardized for each particular use, and identification is easier because of this fact.

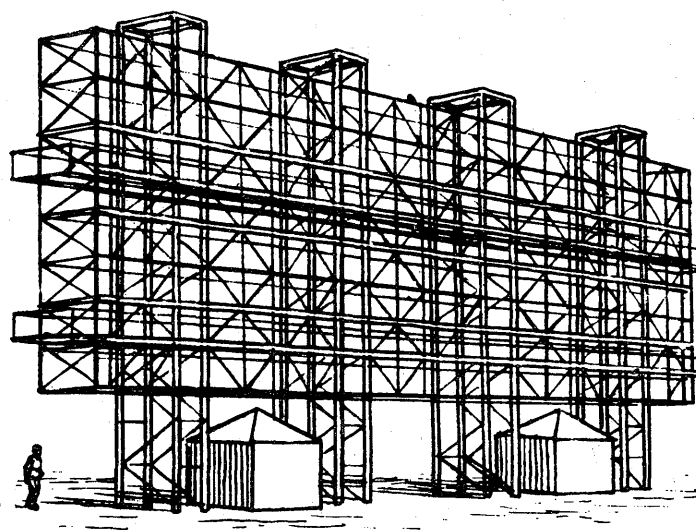
In most cases, this German equipment is superior to that now in use by the Japanese. A constant watch for German type designs of Radar in Japanese held territory is therefore in order.



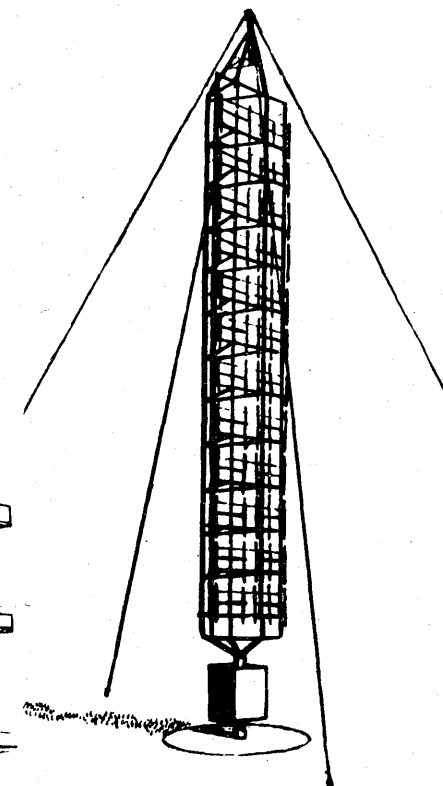
CYLINDRICAL CHIMNEY



SMALL HOARDING



LARGE HOARDING



GIRDER CHIMNEY

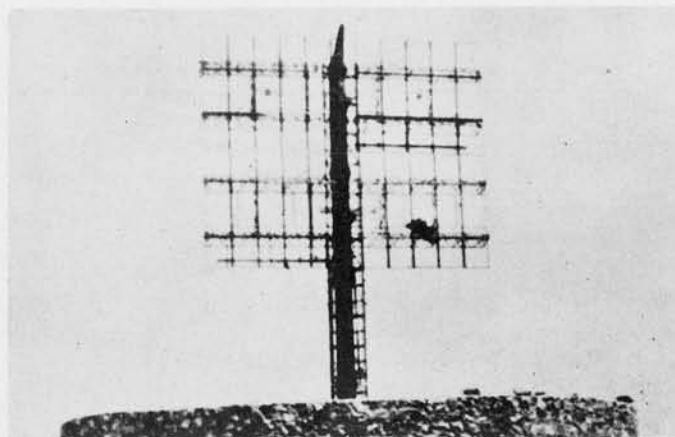
# RADAR (GERMAN)

## FREYA

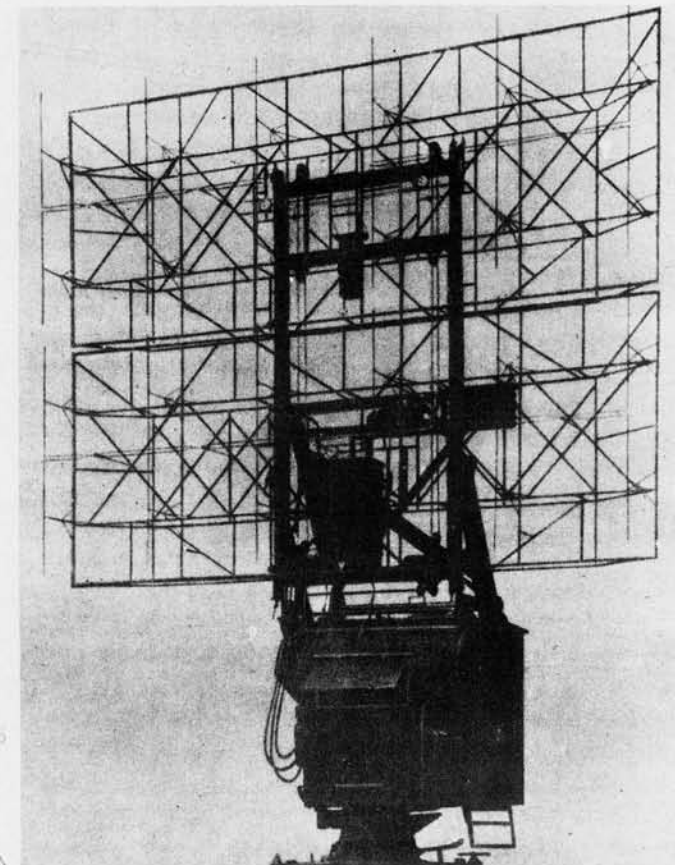
The Limber Freya is one of the earliest types of German equipment, developed for air search or early warning. The Pole Freya is a later mechanical development, but the electrical performance is much the same. Both types may or may not support the I.F.F. array. The operating cabin is 7' square.

The high blast wall is a characteristic of Freya installations. This Pole Freya is minus the I.F.F. The Pole type is assembled from a number of small parts, thus making it more suitable for air transport.

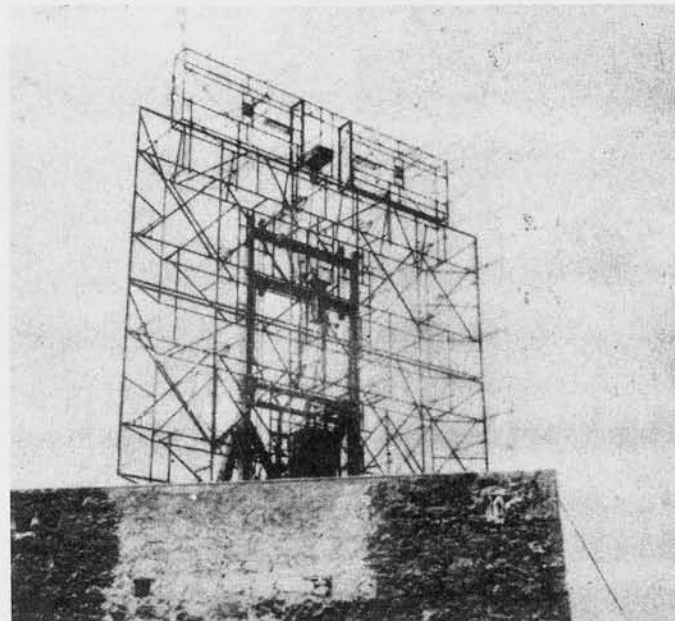
Practical range of Limber Freya is 75 Naut. miles. Practical range of Pole Freya is 100 Naut. miles. Frequency is 116 - 146 Mcs.



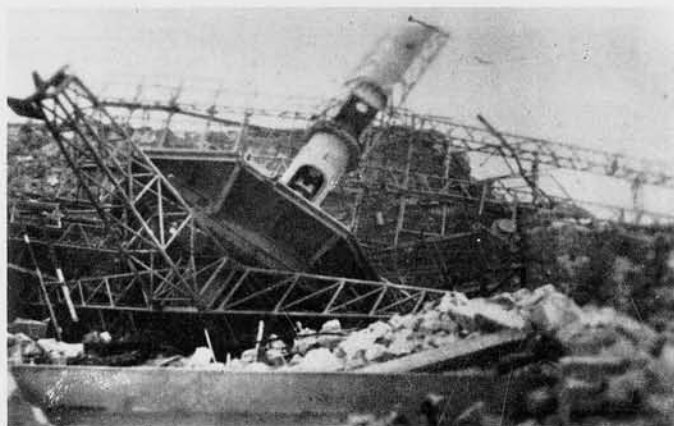
POLE FREYA



LIMBER FREYA

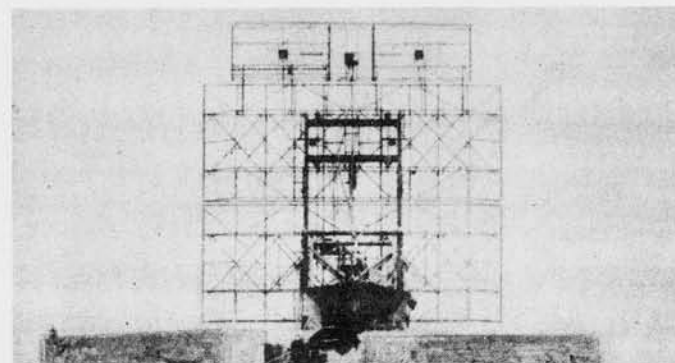


LIMBER FREYA WITH I.F.F.

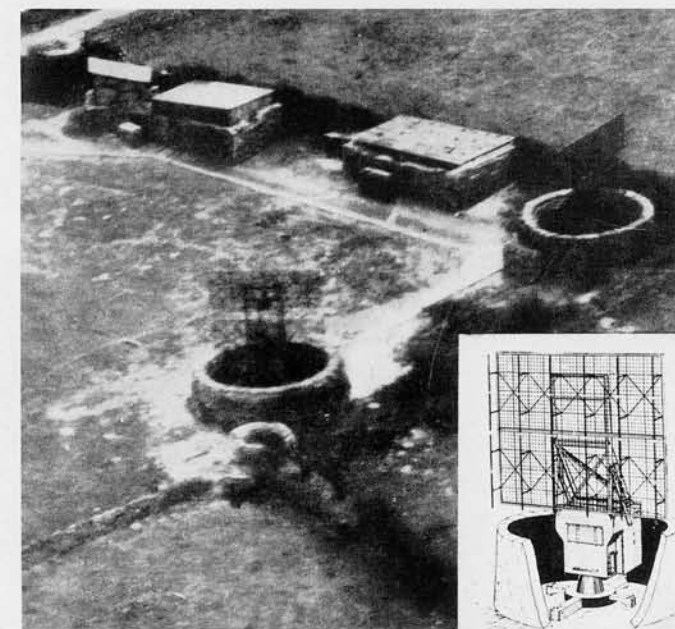


POLE FREYA

Two views of badly damaged Pole Freya, showing details of the Pole support for aerial and the four arm girder-like base supporting the turn table. The operating cabin is octagonal in plane view (approx. 10' across). Note giant Wurzburg in the background.



LIMBER FREYA WITH I.F.F.



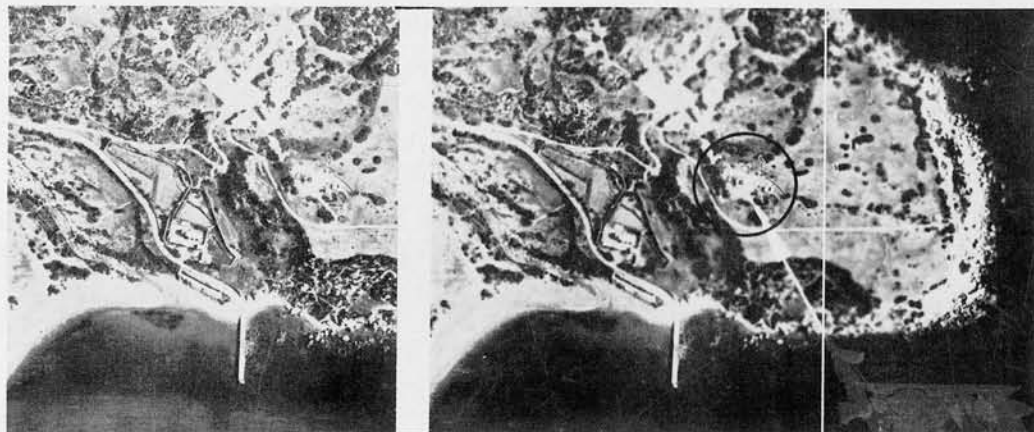
LIMBER FREYAS

CONFIDENTIAL



# RADAR (GERMAN)

## FREYA (CONT.)



FREYA

(R.F. - 1/8000)

The Freya is the most used of German Search Radar and is employed in a variety of ways, among which are early warning, ground control of A/C, and coastwatching, etc.

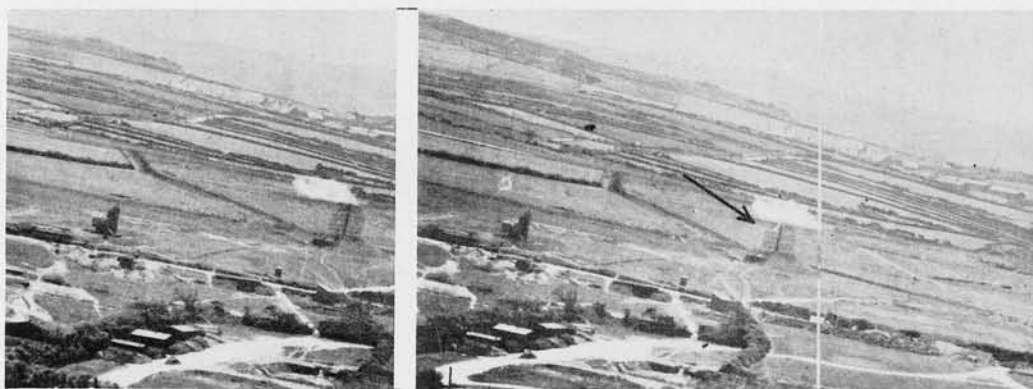


FREYA

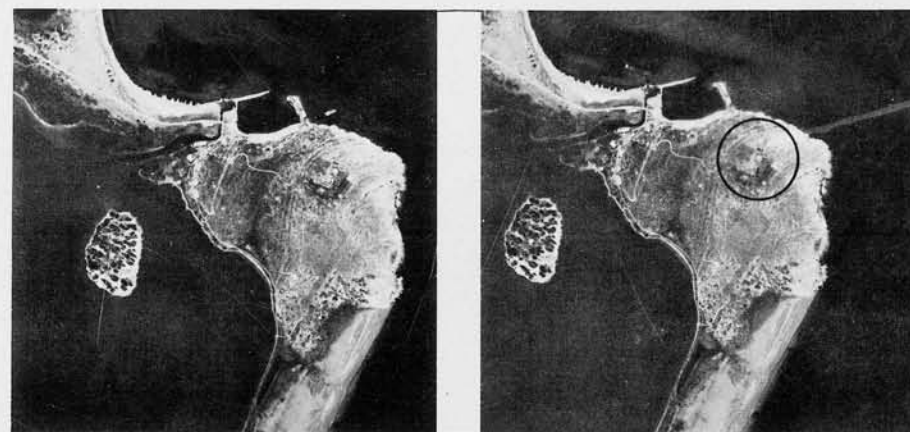
(R.F. - 1/10000)

Above are seen two Freyas (one in stereo), which appear to be in conjunction with S/L Stations.

The oblique stereogram shown below contains one Pole Freya with 16' wide I.F.F. and one giant Wurzburg.

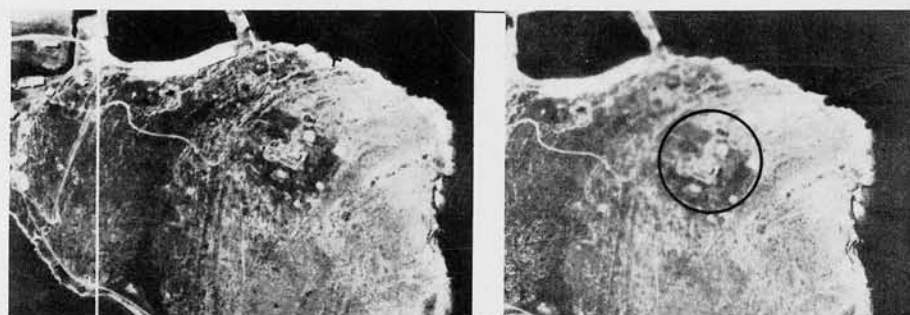


POLE FREYA WITH GIANT WURZBURG



FREYA

(R.F. - 1/15200)



FREYA

(R.F. - 1/7500)

BELOW: This installation in Greece shows a Pole Freya with the 20' wide I.F.F. under attack by a plane. The encircled object appears to be a portable voice carrying light beam signal device which, although of German design, is also in use by Japanese. Its range is approximately 8 miles and it cannot be jammed or intercepted successfully.



POLE FREYA WITH I.F.F.

# RADAR (GERMAN) CHIMNEY

On this page are shown two types of Chimney Radar- the Girder type and the Cylindrical type.

The Girder type consists of a triangular or square (in transverse section) girder mast rising out of a short steel column, which is in turn, fitted to a socket on the ground. The radar equipment is in the cabin at the bottom. Steel guy wires secured at the top, assist in supporting. The screen is  $19\frac{1}{2}'$  wide by  $97\frac{1}{2}'$  high. Practical range is 110 Nautical Miles.

Frequency is 120 - 130 Mcs.

The Cylindrical type has a large partly buried concrete casemate, at one end of which is set up a hollow steel cylinder, 130 feet high and 8 feet in diameter surmounted by a crane arm for hoisting frames into position. The screen varies in width somewhat but is likely to be about 60 feet, usually by  $97\frac{1}{2}$  feet high.

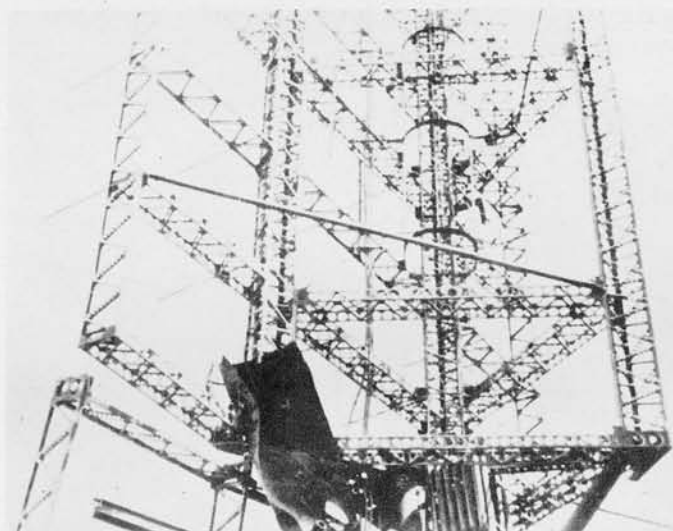
Both types rotate, are capable of long range reporting, and operate at the same frequency of 120-130 Mcs.

Practical range is 160 Nautical Miles.

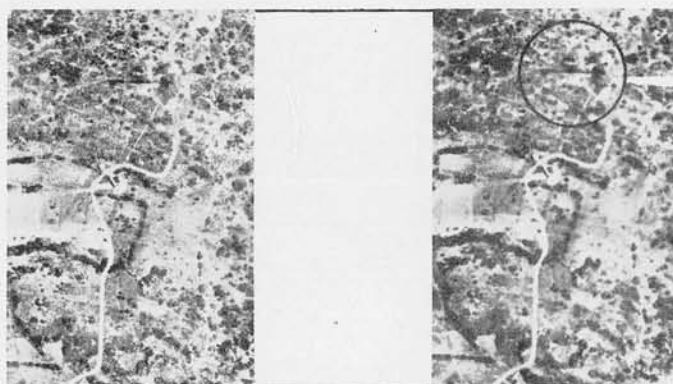
Frequency is 120 - 130 Mcs.



GIRDER CHIMNEY

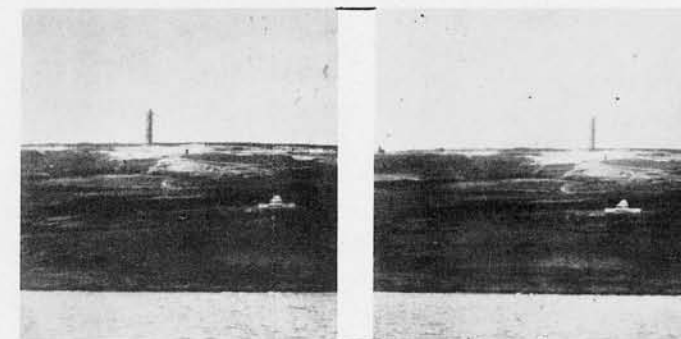


GIRDER CHIMNEY



GIRDER CHIMNEY

(R.F. - 1/8000)



CYLINDRICAL CHIMNEY

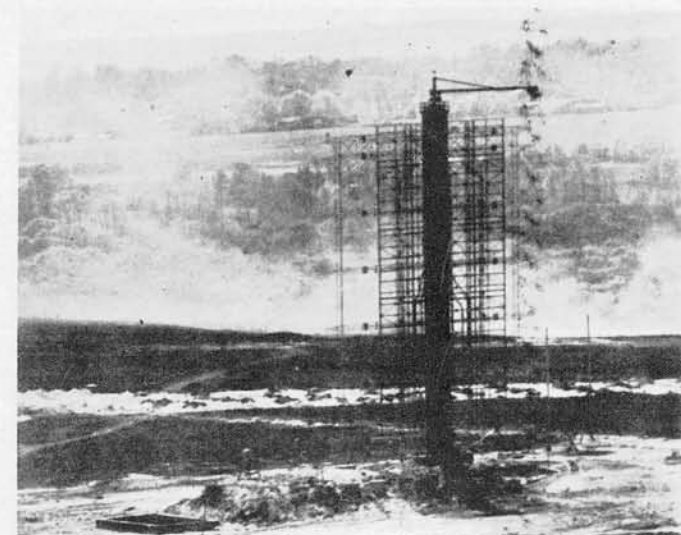
The strong vertical form of cylinder is discernable at long distances.



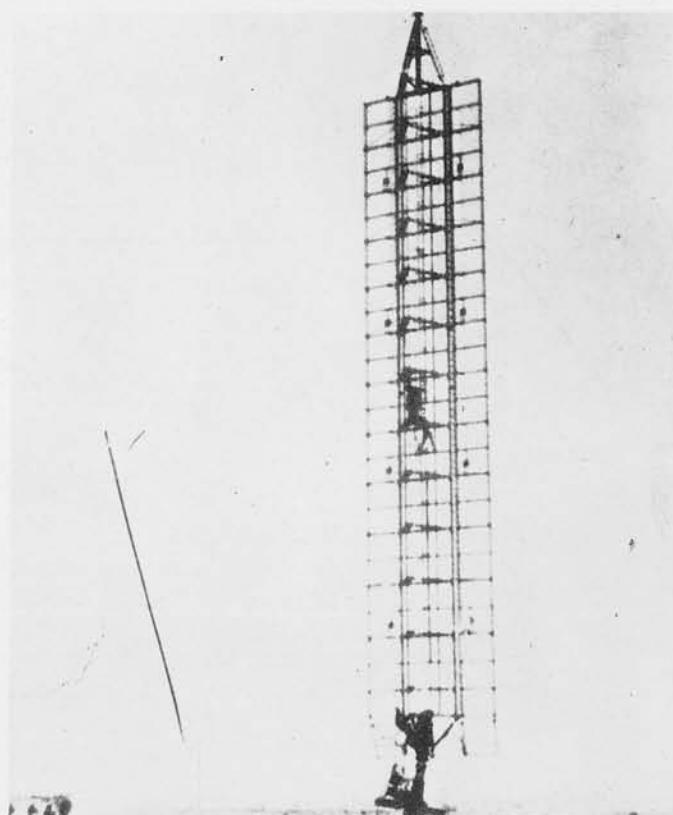
(R.F. - 1/10000)

CYLINDRICAL CHIMNEY

The width of the screen, in vertical view, makes identification comparatively easy.



CYLINDRICAL CHIMNEY



GIRDER CHIMNEY

CONFIDENTIAL



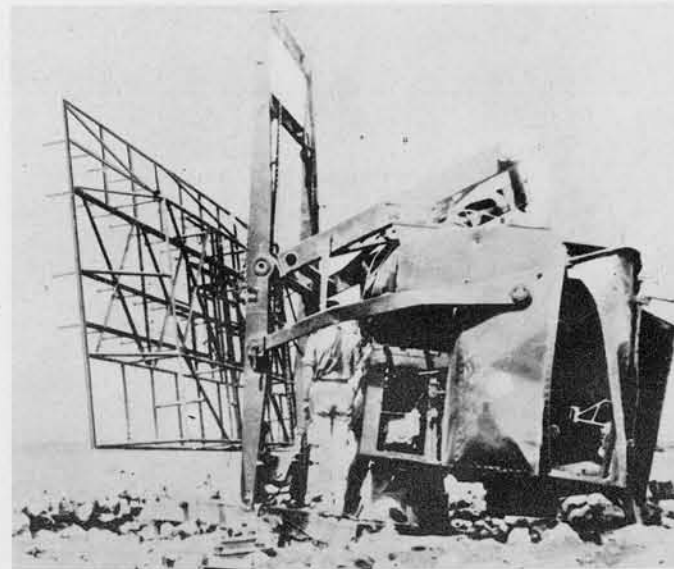
# RADAR (GERMAN) COASTWATCHER

There are two types of German Coastwatcher Radar, the "Gema Coastwatcher" and the "Large Coastwatcher".

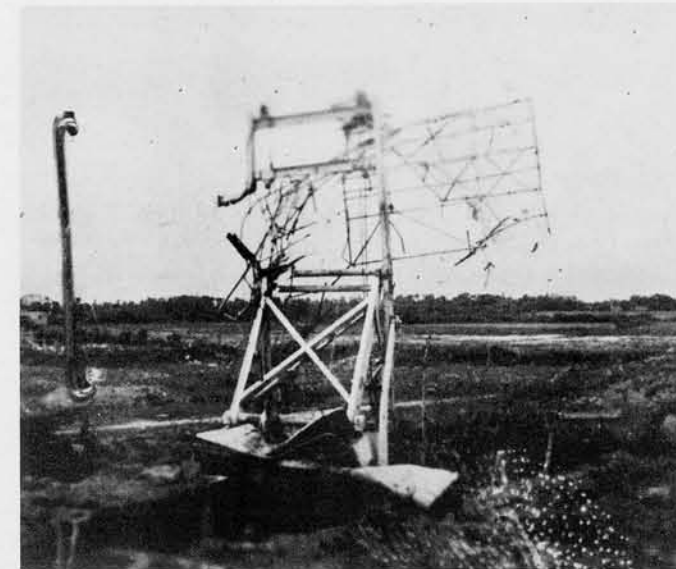
The Gema Coastwatcher, shown on this page, is used for detection of ships approaching the coast and for securing range and bearing for fire of coast defense guns.

The aerial is similar to Freya and is 20 feet wide by 8 feet high. The whole apparatus rotates in azimuth.

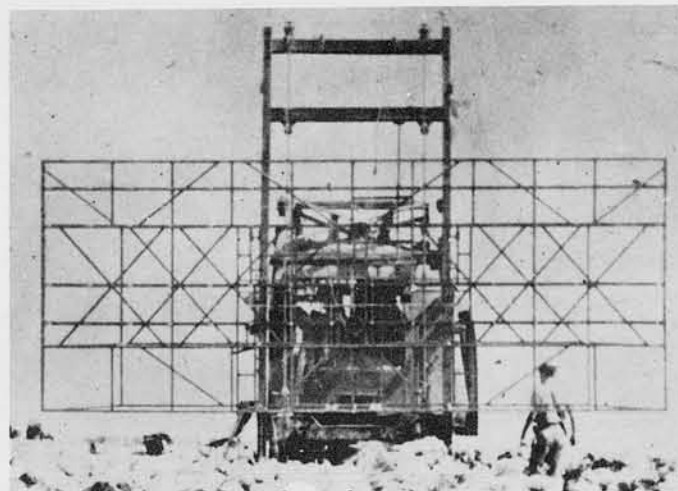
The aerial is always mounted on limbers, but may be sited on the ground or on top of a building such as the octagonal tower shown on this page. Range varies with the elevation of the set above sea level. It is 20 Naut. Miles at 250 feet A.S.L. Frequency is 370 - 390 mcs.



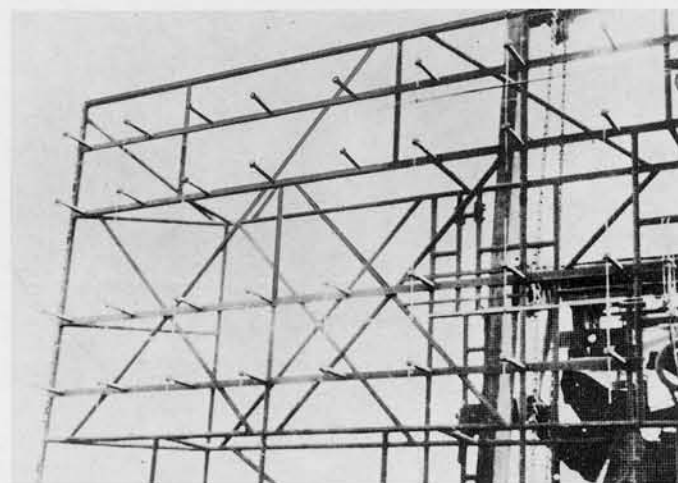
GEMA COASTWATCHER



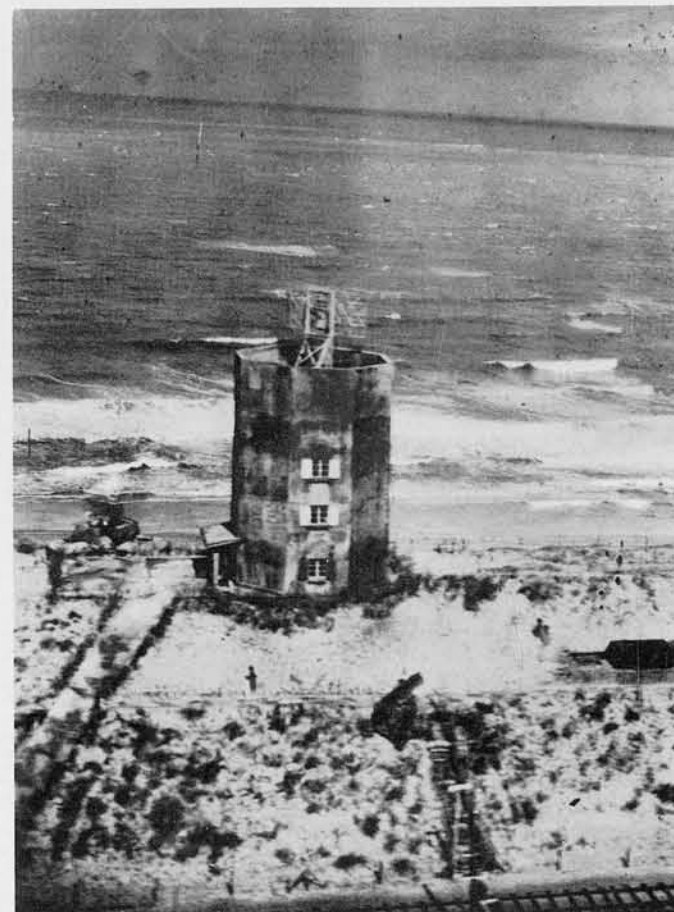
GEMA COASTWATCHER



GEMA COASTWATCHER



GEMA COASTWATCHER



GEMA COASTWATCHER

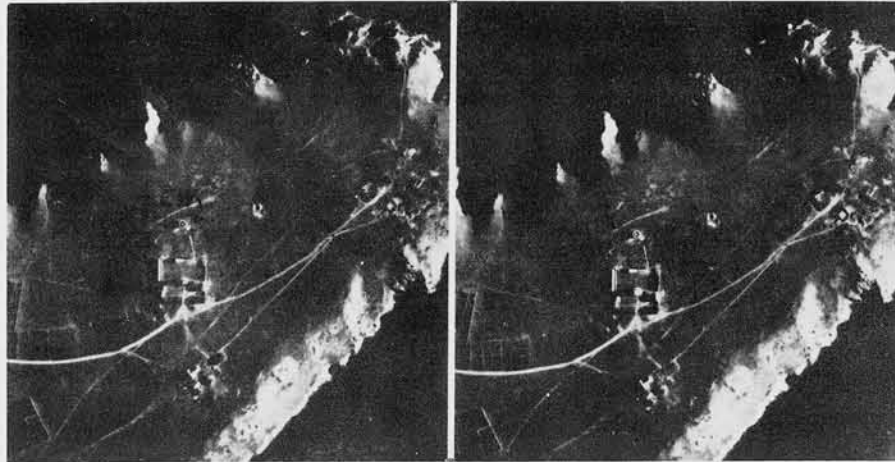


GEMA COASTWATCHER



# RADAR (GERMAN)

## COASTWATCHER (CONT.)



GEMA COASTWATCHER

(R.F. - 1/11000±)

On this page is shown the "Large Coastwatcher" as well as other views of the "Gema Coastwatcher".

The Large Coastwatcher is a late addition to the list of German Radar, and at the time of the Normandy invasion, little was known in detail concerning its characteristics.

The aerial or screen is nearly square in shape, being 35 feet wide by 34 feet high. The screen and cabin rotate in azimuth.

Its main purpose is the detection of ships.

Practical range of Large Coastwatcher is 60 - 75 nautical miles

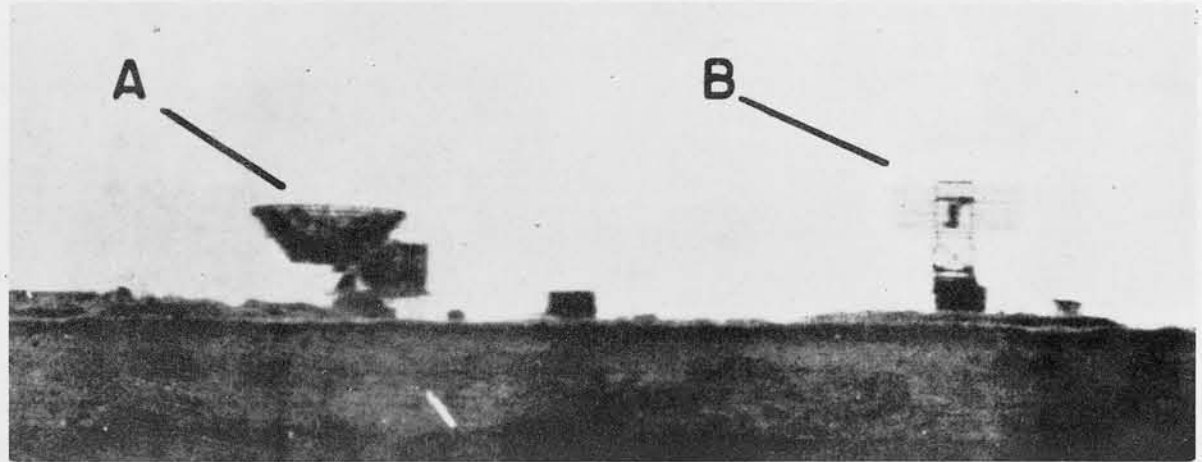
Frequency is 70 - 90 mcs.



LARGE COASTWATCHER

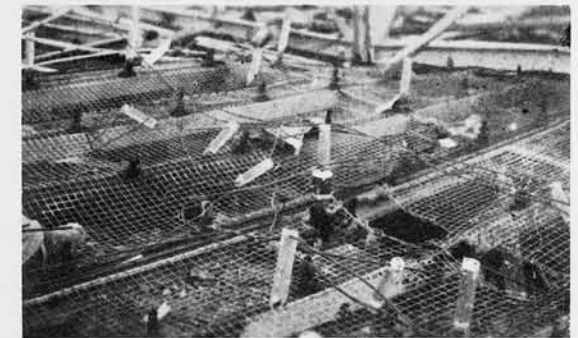
(R.F. - 1/11000±)

"LCW"- LARGE COASTWATCHER; "SH" - SMALL HOARDING



GEMA COASTWATCHER

"A" - GIANT WURZBURG; "B" - GEMA COASTWATCHER.



LARGE COASTWATCHER



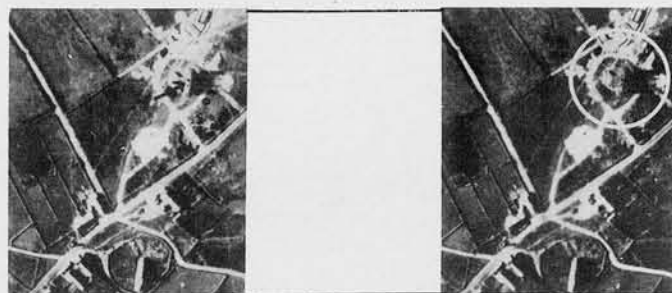
LARGE COASTWATCHER

CONFIDENTIAL

# RADAR (GERMAN) HOARDING

The "Hoarding" apparatus (sometimes called "Mammut") is for long range aircraft reporting, measuring range and bearing. The screen is fixed and is not capable of rotation. Searching is achieved by electrical swinging of the beam. The Large Hoarding consists of a screen 98 feet long by 36½ feet high, looking very much like a billboard. Four heavy vertical girders set in concrete bases give support to the screen. The screen usually consists of two fixed broad-side arrays, one attached to each side of the vertical girders.

Practical range of Large Hoarding is 100 - 115 Nautical Miles. Frequency is 120 - 130 Mcs.

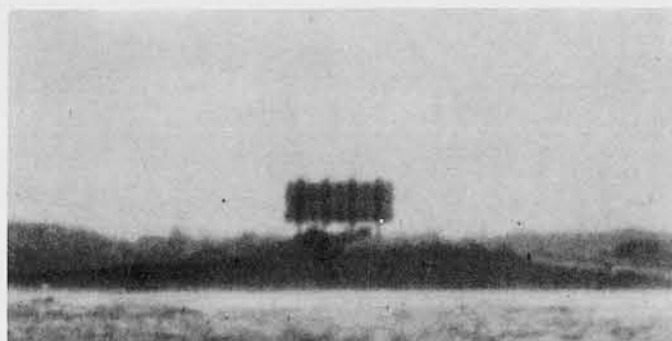


LARGE HOARDING

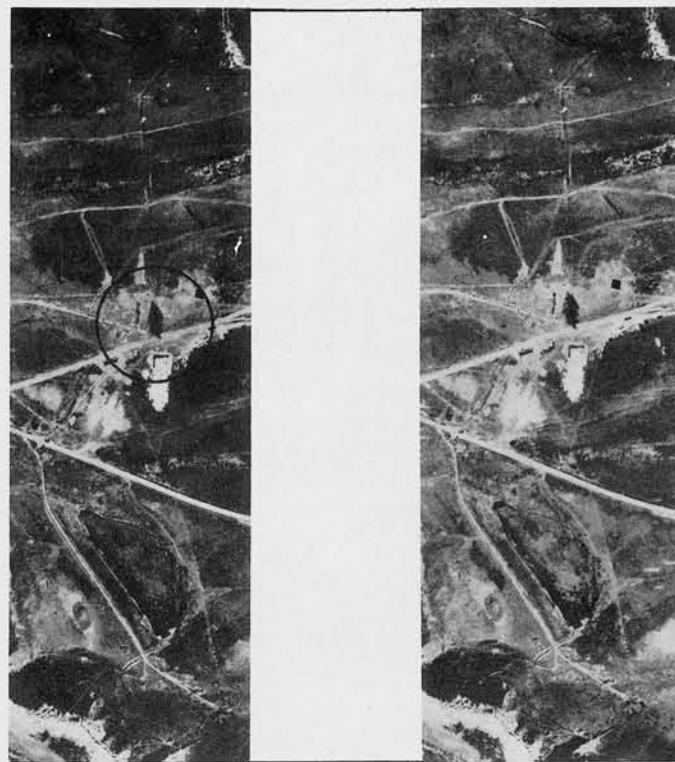
(R.F. - 1/11000)



LARGE HOARDING



LARGE HOARDING



LARGE HOARDING

(R.F. - 1/10000)



LARGE HOARDING

(R.F. - 1/5700)

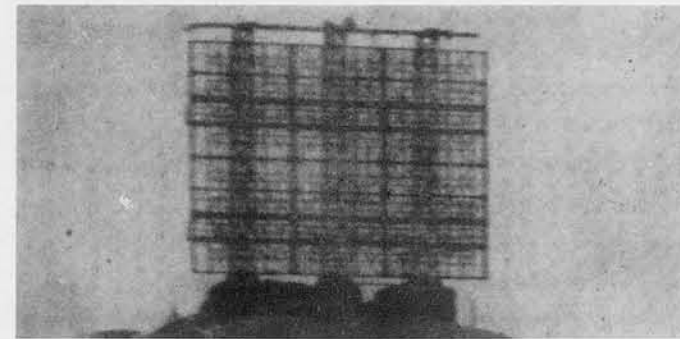


LARGE HOARDING

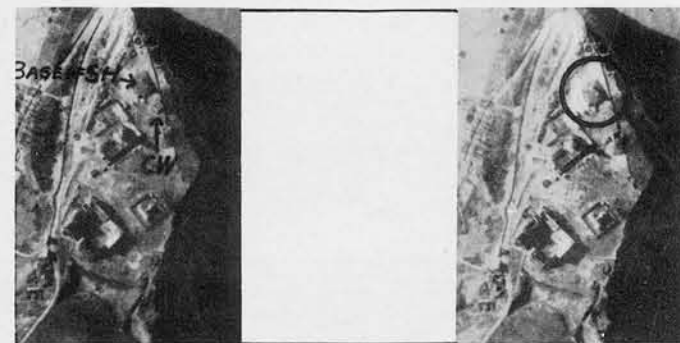
A very recent type of German Radar is the Small Hoarding. This apparatus is probably also for coastwatching, and bears a strong similarity to the Large Hoarding, although smaller.

The screen is 63 ¾ feet long by 44 ¾ feet high and is supported by three vertical girders set in concrete bases. The two outside bases are larger than the middle one.

At the top of the vertical girders runs a horizontal rail or bar, which is probably used for hoisting screen into place.

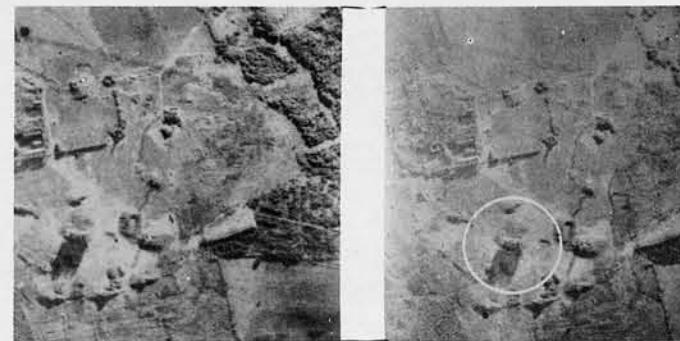


SMALL HOARDING



BASE OF SMALL HOARDING

(R.F. - 1/11000±)



SMALL HOARDING

(R.F. - 1/9000±)



# RADAR (GERMAN) SMALL WURZBURG

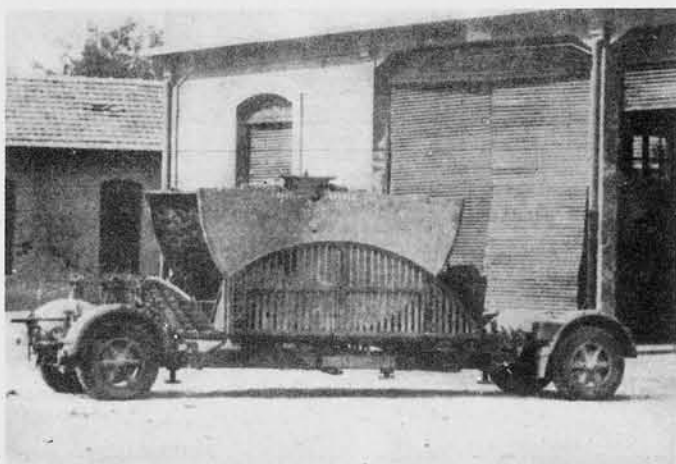
The "Small Wurzburg" or "Bowlfire" was first designed in 1936, and is one of the most efficient Radars. It is primarily for A.A. fire control but has been used for A/C reporting, searchlight control, and as a standby for Ground Control of A/C. In general, it is a mobile Radar, mounted on a four-wheeled trailer with outriggers for levelling. Some sets are emplaced, however, and the wheels removed.

Search is by mechanical rotation of the apparatus for bearing and by elevation of the reflector bowl for height measurement.

The diameter of the paraboloid reflector is 10 feet, the top of which is but 12½ feet above the ground. A cupboard, housing the radar equipment, and an operators seat are attached to the rear and side of the reflector.

There are several types of Small Wurzburgs; among them Types "A", "C", and "D" are most used and are quite similar. Type "D" is found with limber mounting and may be without wheels or even set in concrete.

For transport, the paraboloid can be split, by hinges, and turned down in two halves. (See below)



WITH BOWL TURNED DOWN

RIGHT: Type F.M.G. 41-T is a modification of the Small Wurzburg which incorporates a scoop-like form for cutting out ground echoes.

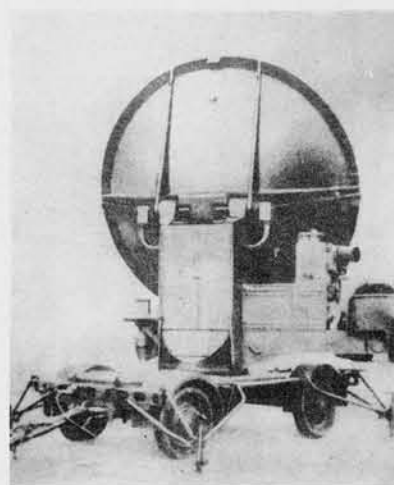
The practical range of the Small Wurzburg is not more than 25 nautical miles but it has a high degree of accuracy for Fire Control purposes.



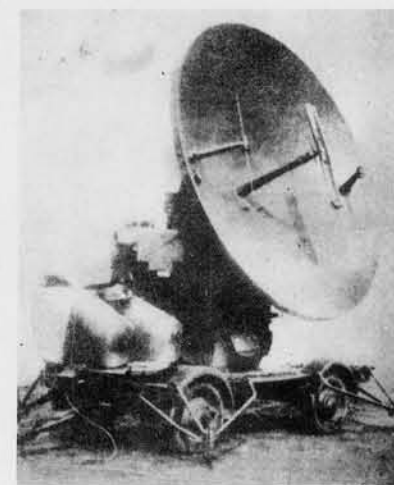
(NO PARALLAX)

TWO SMALL WURZBURGS

(R.F. - 1/5000)

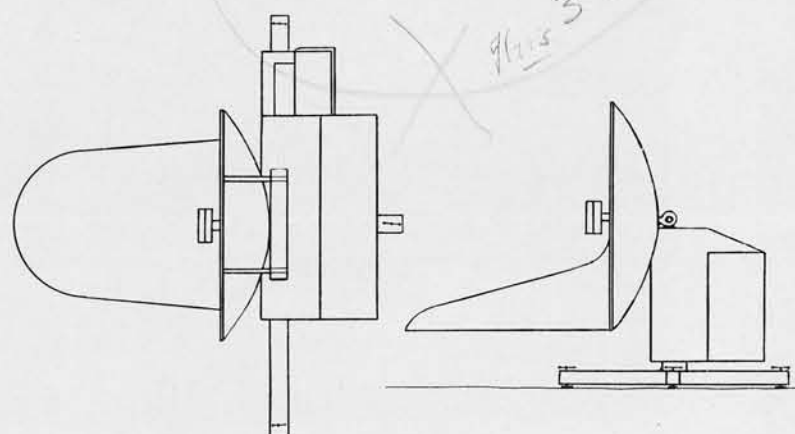


REAR

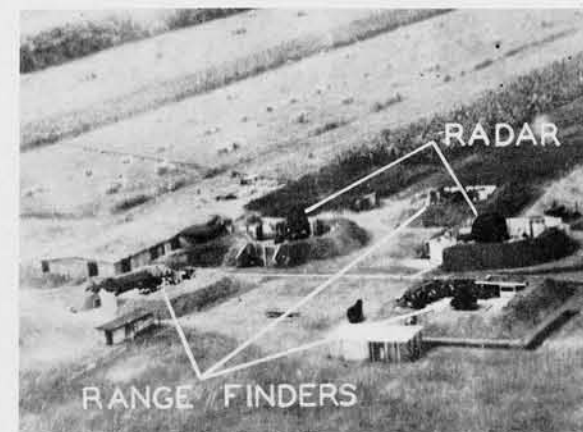


FRONT

SMALL WURZBURG



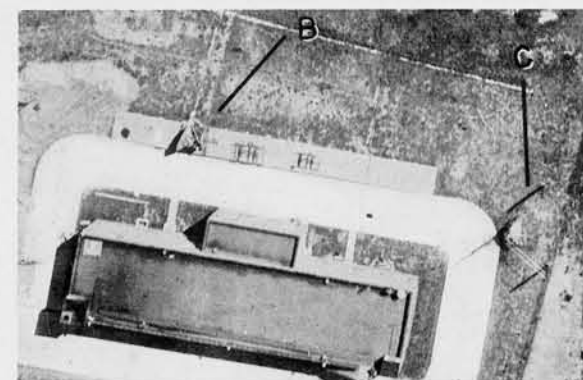
MODIFICATION OF SMALL WURZBURG



TWO SMALL WURZBURGS

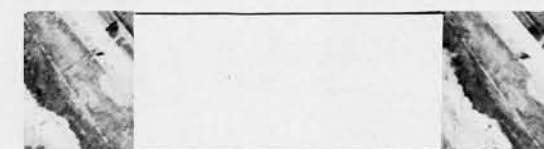


SMALL WURZBURG AT BRUNEVAL



(R.F. - 1/1000)

SMALL WURZBURG IN U.S.A.



(R.F. - 1/2500)

SMALL WURZBURG IN U.S.A.

CONFIDENTIAL



# RADAR (GERMAN)

## GIANT WURZBURG

The Giant Wurzburg is a fixed (non-mobile) Radar for measuring range, bearing and height of target aircraft. The whole equipment rotates in azimuth, and the paraboloid tips upward for height finding. Its principal use is for Ground Control Intercept, but some are used for ship-watching.

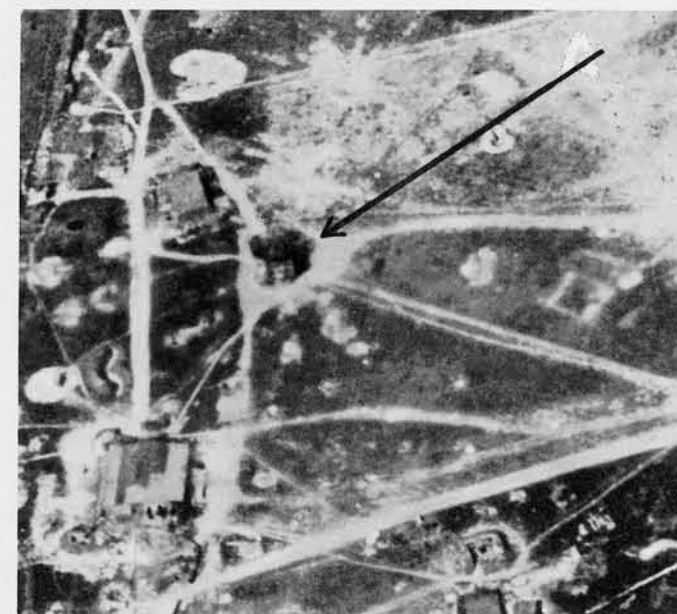
The basket type metal paraboloid has a diameter of 24 feet.

The large cabin (16'x10'x8½' high) rotates with the screen on a turntable which is, in turn, set on a concrete base. In upright position, the top rim of the paraboloid is 27 feet above the ground. An I.F.F. array, consisting of two pairs of dipoles, is located at the top of the paraboloid rim.

The Giant Wurzburg has been used in great numbers throughout German occupied Europe as a multi-purpose Radar. Practical range of the Giant Wurzburg is 40 N. Mi. Frequency is 470-580 Mcs.



GIANT WURZBURG



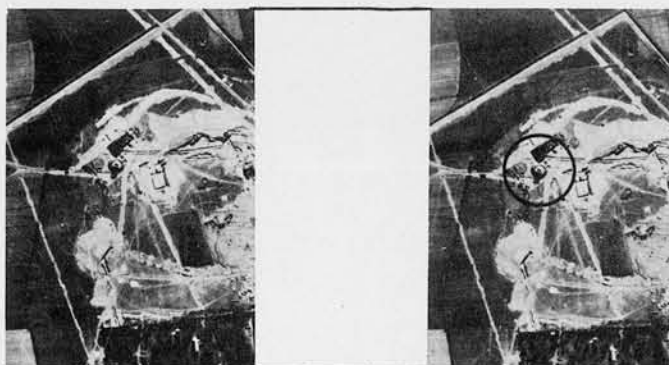
GIANT WURZBURG



GIANT WURZBURG



GIANT WURZBURG

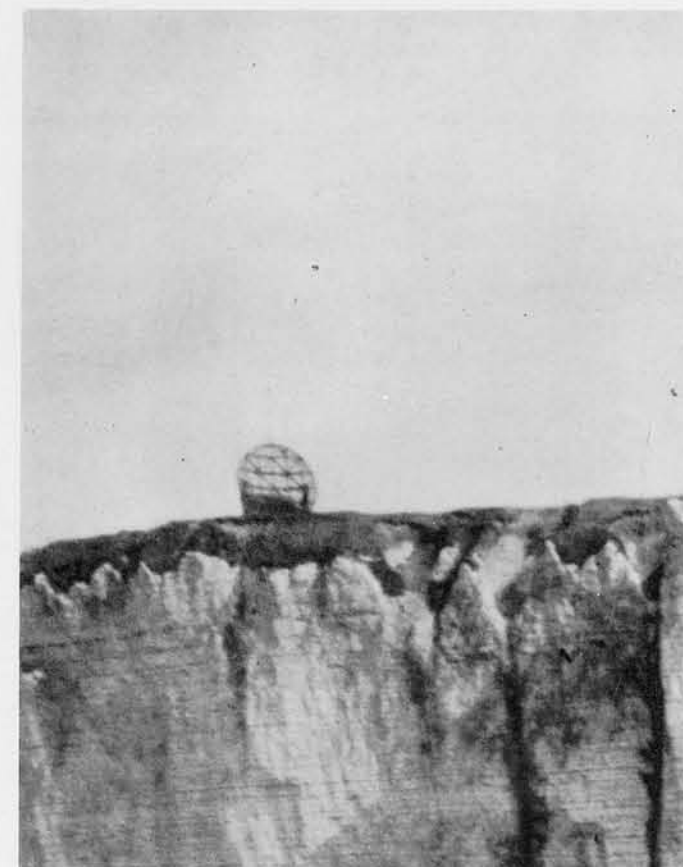


GIANT WURZBURG

(R.F. - 1/8500)



GIANT WURZBURG NEAR COAST



GIANT WURZBURG AS COASTWATCHER

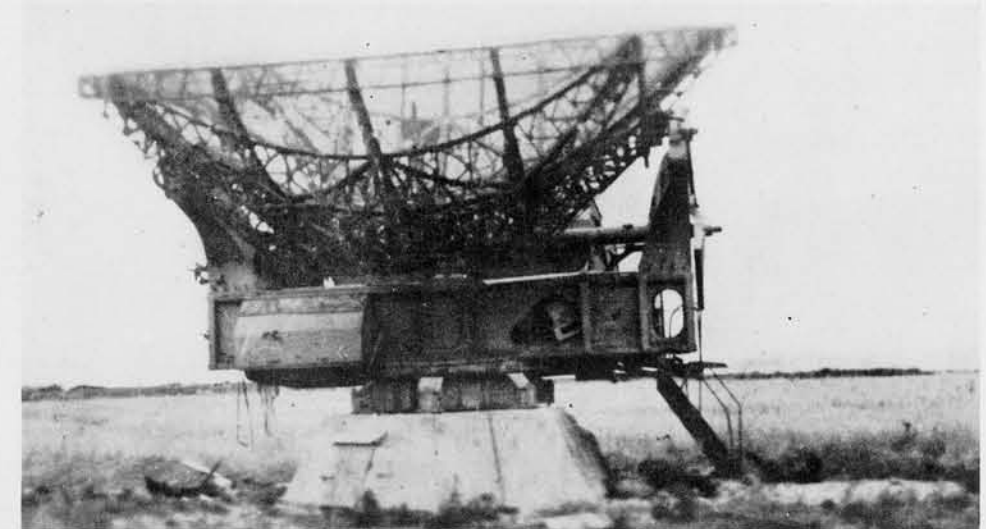
# RADAR (GERMAN)

## GIANT WURZBURG (CONT.)

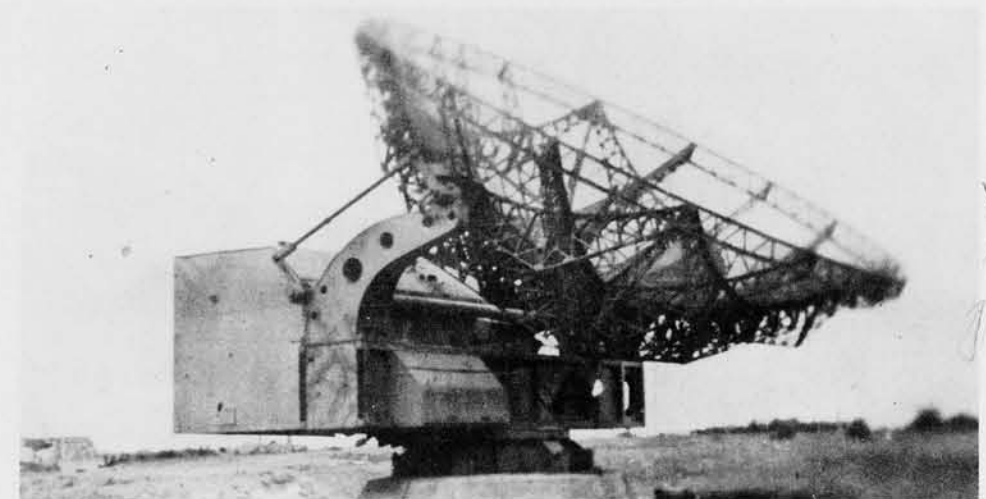


GIANT WURZBURG

Most of these views show the paraboloid of the Giant Wurzburg in uplifted position. The girders are of a light metal alloy. The "Basket" form is used instead of a "Bowl", because of wind resistance offered by such a large surface area.



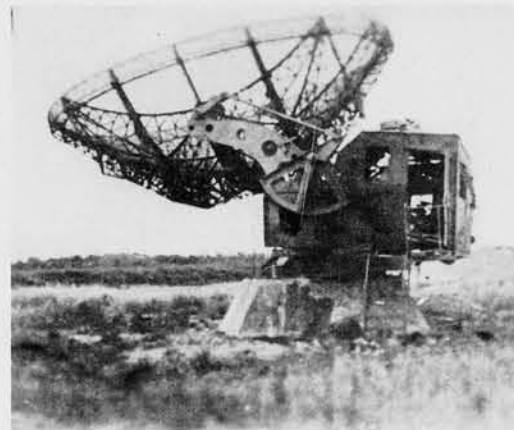
GIANT WURZBURG - FRONT VIEW



GIANT WURZBURG - 3/4 VIEW



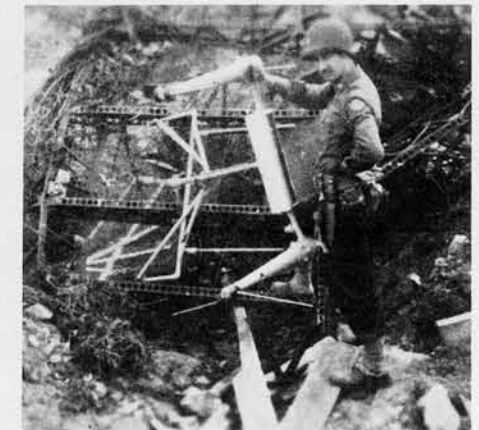
GIANT WURZBURG - REAR VIEW



GIANT WURZBURG - SIDE VIEW



G.W. SUPPORTING TRUNNIONS



G.W. I. F. F. ARRAY

**CONFIDENTIAL**



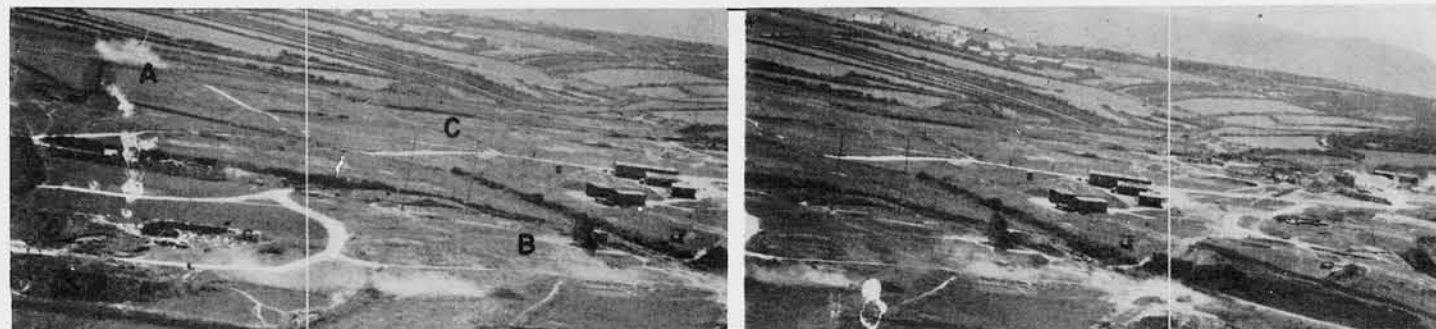
# RADAR (GERMAN) COMBINATIONS

Most German Radar stations, excepting some Hoarding and Chimney sites and a few Ship Watching sites, are provided with several pieces of equipment.

The most common station, the Coastal Early Warning Station, usually has two Freyas and one or two Wurzburgs. The Freyas are in circular emplacements.

The typical G.C.I. station has two Giant Wurzburgs, one Freya, and occasionally a Small Wurzburg.

Ship watching stations have one Coastwatcher and a Small or Giant Wurzburg.



RADAR STATION - FRANCE

"A" - POLE FREYA; "B" - GIANT WURZBURG; "C" - RADIO COMMUNICATIONS



RADAR STATION - FRANCE

"A" - LARGE COASTWATCHER  
"B" - GIANT WURZBURG



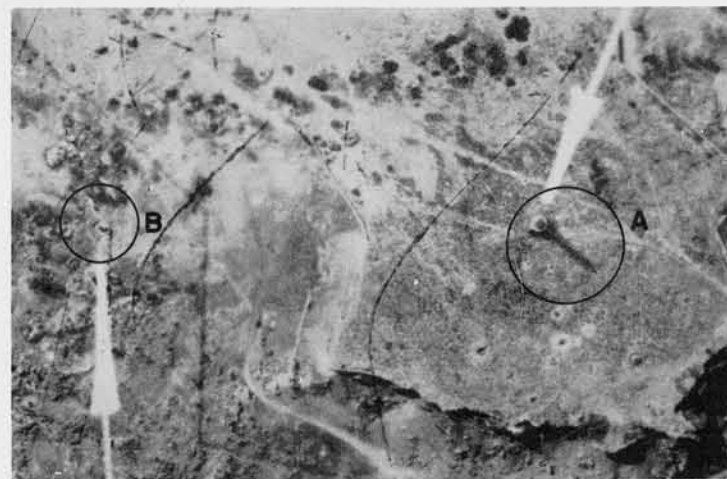
RADAR STATION - FRANCE

"A" - RADIO COMMUNICATIONS  
"B" - 2 GIANT WURZBURGS  
"C" - POLE FREYA



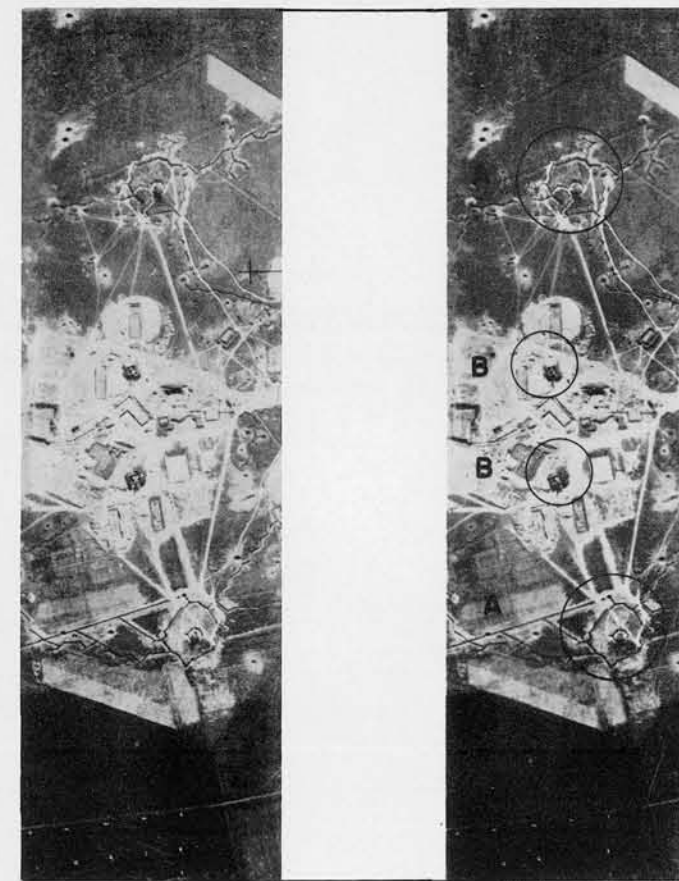
RADAR STATION - FRANCE

"A" - 2 LIMBER FREYAS  
"B" - 1 GIANT WURZBURG



RADAR STATION - CRETE

"A" - GIRDER CHIMNEY  
"B" - SMALL WURZBURG



RADAR STATION - FRANCE

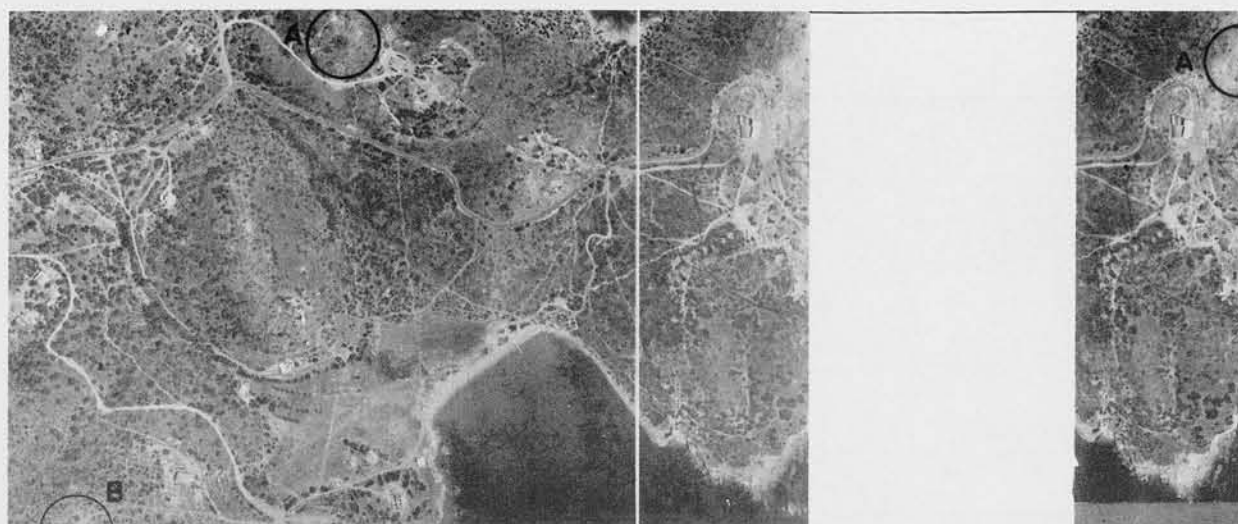
"A" - 2 GIANT WURZBURGS  
"B" - 2 LIMBER FREYAS

(R.F. - 1/5000±)

(R.F. - 1/7000±)



# RADAR (GERMAN) COMBINATIONS (CONT)



RADAR STATION - GREECE

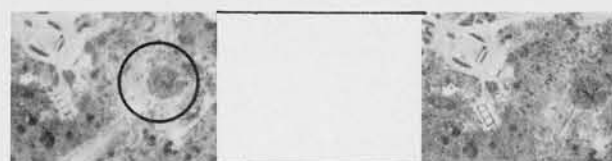
(R.F. - 1/10000)

"A" - 2 LIMBER FREYAS; "B" - GIANT WURZBURG



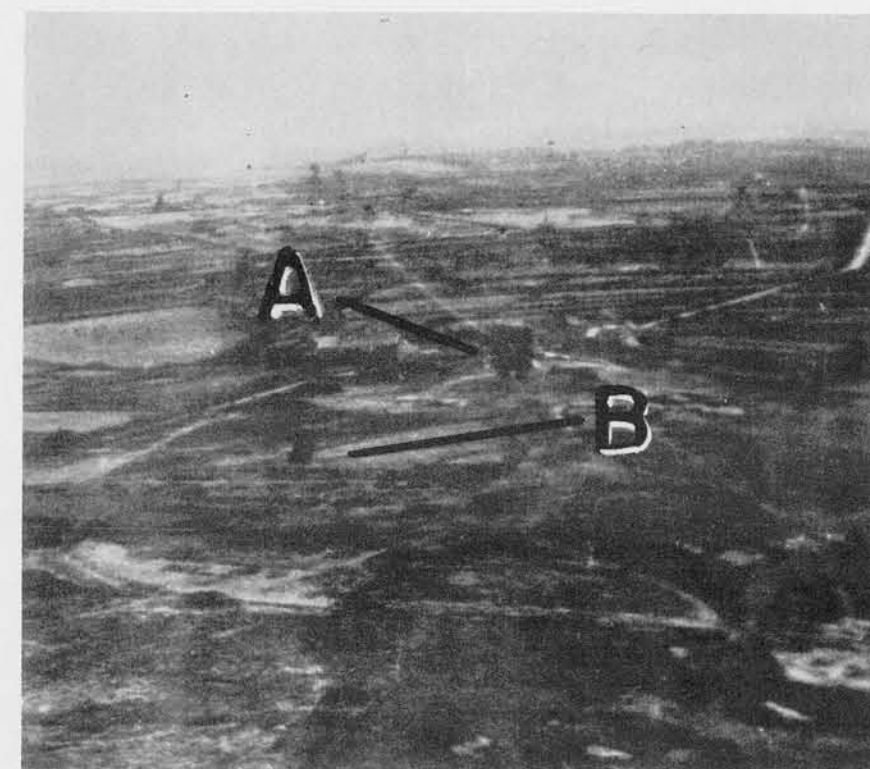
(R.F. - 1/5000)

GIANT WURZBURG



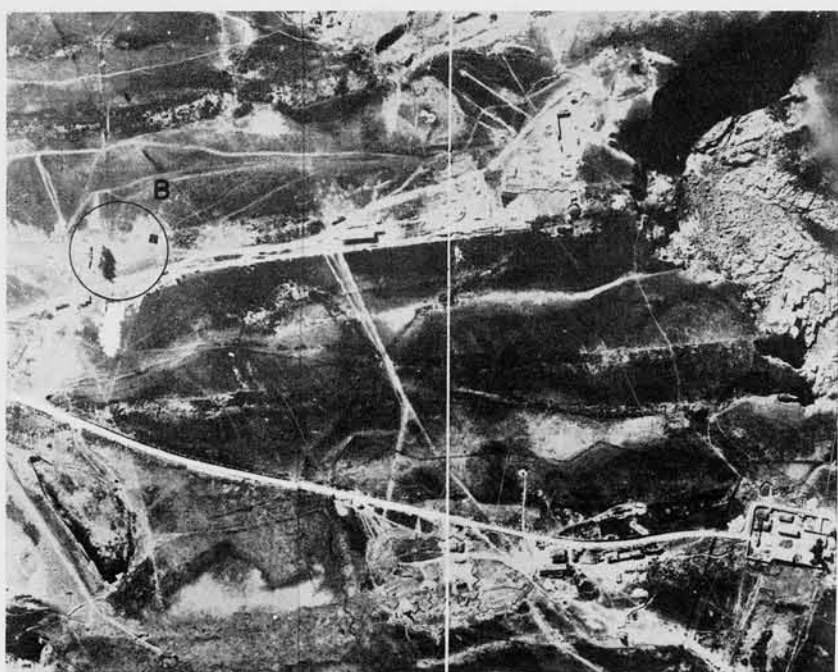
(R.F. - 1/5000)

LIMBER FREYA



RADAR STATION - FRANCE

"A" - LARGE HOARDING; "B" - GIANT WURZBURG

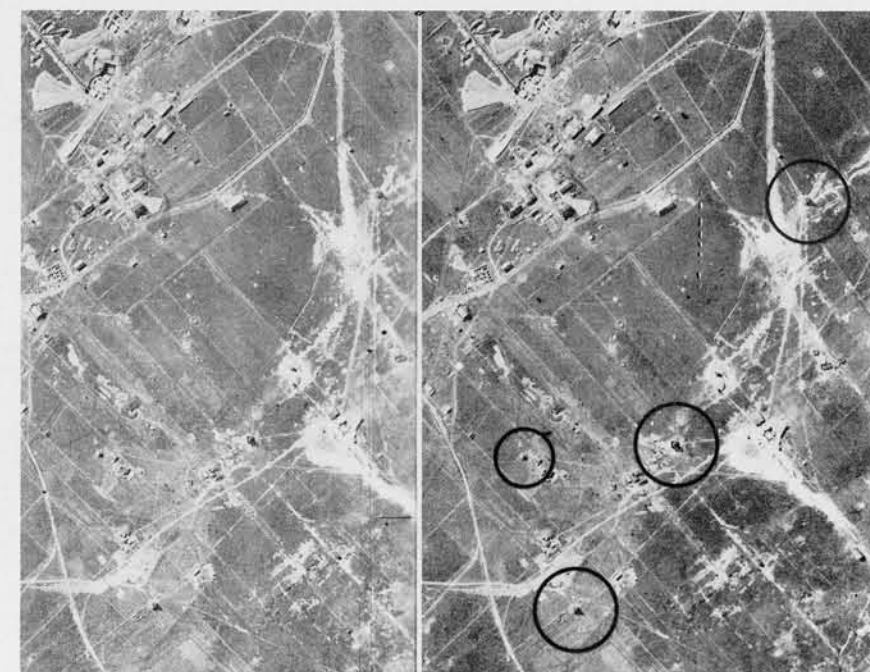


RADAR STATION - FRANCE

"A" - 2 GIANT WURZBURGS; "B" - LARGE HOARDING



(R.F. - 1/10000)



RADAR STATION - FRANCE

"A" - 2 GIANT WURZBURGS; "B" - FREYA; "C" - SMALL WURZBURG

(R.F. - 1/8000)

CONFIDENTIAL

## SUPPLEMENTARY MATERIAL

## SUPPLEMENTARY MATERIAL



## SUPPLEMENTARY MATERIAL